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Forthcoming Events.

SEPTEMBER 17-25.
Model Engineer Exhibition at Royal Horticultural Hall, Westminster, S.W.

SEPTEMBER 27-OCTOBER 1.
American Foundrymen's Association:—Congress at Detroit, U.S.A.

OCTOBER 4-9.
Motor Cycle and Cycle Exhibition at Olympia, London, W.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1926-27: V. C. Faulkner, 49, Wellington Street, London, W.C.2.

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Middlesbrough: N. D. Ridsdale, 3, Wilson Street, Middlesbrough.

Welsh Engineers' and Founders' Association.
Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Essential Supplies.

The coal stoppage has thrown on to the foundry industry of Great Britain a burden which the industrial conditions of the last five years have ill fitted it to support. Yet through all, it adapts itself in a really splendid manner to the ever-altering circumstances. Since the inception of the coal dispute its normal sources of raw materials have been gradually drying up, yet in spite of everything, one large foundry owner stated to us last Saturday that not an hour had been lost since May 1, while another prominent foundry owner tells of a record output for both July and August. They both own foundries which are technically well equipped. Coke to them is an aggregation of fixed carbon, volatile matter, ash and sulphur, whilst pig-iron is a complex alloy, the constitution of which has to be determined before use. Thus equipped they have been able to utilise Westphalian coke, or Dutch pig-iron, or other foreign material without noticing any appreciable effect on quality. Obviously, selling prices have had to be adjusted, but admirable restraint has been exercised by the majority. It is less than a fortnight since one large steel foundry notified its customers of an increase in price. We are constantly being asked whether we would advise extensive future Continental buying owing to a possible general resumption. Whilst refraining from prophesying, it can be stated with a good deal of certainty that the demand for coke and pig-iron is likely to be heavy for a considerable period, until stocks have become normal. Some of the foreign material, especially certain consignments of coke, have been of poor quality. Those founders who have been unable to use it with complete satisfaction will return to their normal supplies as soon as possible. This will tend to stiffen the price of the home-produced material as compared with pre-strike prices, and to depress the price of imported material. Thus we doubt if forward buying would be advantageous, though it will be necessary in many cases to continue utilising these sources for some time to come—at a minimum two months. If not so serious, it would be positively humorous to chronicle the expressions of opinion various foundrymen have vouchsafed to us on the subject of, say, German coke. They are either loud in their praise or positively blatant in their condemnation of what they erroneously conceive to be an average sample.

Whilst everybody hopes that this will be the last of national coal strikes for at least a decade, it would be of advantage to the British foundry industry if the individual members would ascertain the source and circulate the result, so that in an emergency quick access could be made to the best market. It would be information of a very valuable type, and worthy of filing in that complete foundry organisation for which we are constantly striving, and the counterpart which already exists in Germany.

Catalogues Received.

Electric Furnaces.—Messrs. Automatic & Electric Furnaces, Limited, of 173-175, Farringdon Road, London, E.C.1, are circularising the industry with a 4-page illustrated leaflet. It is based on testimonials from important works tackling quite different products.

Pig Iron.—We have received an advance copy of a brochure to be issued almost immediately by Messrs. British Pig Irons, Limited, of Abbey House, Victoria Street, London, S.W.1. The book strikes a new note in pig-iron publicity, and full use has been made of the metallurgist. For every brand of iron made there is given a photograph of the fracture; a typical microstucture at a stated magnification; the specified limiting chemical analyses; a description of the microstructure; a paragraph outlining the general nature of the iron, and finally its application in practice. The original ideal inaugurated by this Company was the supplying of pig-iron to definite analysis. Its accomplishment is achieved by the provision of modern stockyards permitting of stacking according to the results obtained from the laboratory. According to the brochure, systematic control has culminated in the ability to produce iron of composition specified by the buyer, provided obviously that it falls within the limit of the capabilities of the plant available. Thus a demand for 0.02 sulphur and phosphorus would not be met from this source. Experience has shown that most demands can be satisfied by working within the limits to be associated with any particular branch. Emphasis is laid upon the superiority of slowly melted iron, a phase of metallurgy which is now occupying the close attention of several of the most prominent of German scientists. Pages 6 to 15 are devoted to a description of the standard brands in the manner described above.

An interesting section carries the caption "Notes to Foundrymen," which after outlining the influence of elements; microstructure and mechanical testing are dealt with in a manner readily understood and appreciated by the ordinary foundryman. Good practical information is contained in a section devoted to cupola practice

Attention is drawn to the "inherent properties" theory in some paragraphs on "The Use of Slow-smelted Pig-iron," and Mr. H. J. Young is credited with its origination. Whilst not flatly contradicting this, we should require a good deal of proof before accepting it, and without research would feel more inclined to credit the late Mr. Robert Buchanan with its conception and elaboration. Finally, emphasis is laid upon technical service, and a tear-out form has been included for the purpose of supplying particulars for the stating of a foundry difficulty. We believe that experience will show the need for its elaboration somewhat to include blast pressure, size of tuveres, the nature of the coke, etc. The reverse, however, is plain paper, and foundrymen utilising this service should give as many details as possible.

For personal use there is given a page ruled out for the recording of mixtures for various jobs and a second for the recording of analyses. Enclosed with the booklet is a folded wall sheet containing eleven excellent microphotographs with descriptions, which have been prepared by Mr. H. J. Young, F.I.C. The central and peripheral graphitic structures at 25 diameters and general structures at 1,000 diameters are given of four brands (two of Midhill and two of Glenhill). These are accompanied by the essential explanatory matters. The booklet contains 32 pages, and the value of the illustrations has been enhanced by the use of a slightly grey-tinted paper. It is jacketed in stiff grey imitation-linen backs.

Maxims for Moulders.

Nothing beats a fair divide.—*Buchanan.*

Manners make a man; methods mark the moulder.—*Buchanan.*

Some moulds are like penny pies—fitter for pork than pig-iron.—*Buchanan.*

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Keighley Laboratories.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Some misunderstandings concerning Keighley Laboratories, Limited, of Croft House, Keighley, which have gained a wide circulation recently, have been brought to the notice of the directors. In order to correct such, the directors wish the following facts to be known:—

The company was originally formed as a result of the interest taken in a series of lectures by Mr. W. H. Poole, suggesting the formation of a fully-equipped Technical Service and Laboratories, where firms who did not see their way to equip private laboratories could send work and problems. Thus small and large firms could be assured of a technical service without the heavy overhead charges and expenses of a private laboratory.

The board of directors consists of representatives of local engineering and foundry firms (who took up shares in the company), but the directors do not discuss or handle the technical side of the business in any way.

It should be clearly understood that the technical work of the laboratories is not confined to, or run by, any individual firm or group of firms. The shareholders are offered exactly the same service as non-shareholders, the fees being the same in both cases.

All work undertaken is confidential to the firms sending in the work, and the results are in no way broadcast or transmitted to any firm or group of firms or association.

To maintain a strictly independent attitude, under instructions from the board, the laboratories are neither agents for nor manufacturers of any kind of foundry material, and they offer a purely technical, consulting and advisory service only.

The foundry public is therefore assured of a purely technical and strictly confidential service, carried out in a metallurgical laboratory having departments fully equipped for chemical, physical, micrographical, and heat treatment for all engineering materials, conducted by a fully qualified staff.—Yours, etc.,

W. H. POOLE,
Managing and Technical Director.
Croft House, South Street, Keighley.
September 13, 1926.

Special Libraries Conference.

The Association of Special Libraries and Information Bureaux is holding its Third Conference during the week-end September 24 to 27 at Balliol College, Oxford. The Rt. Hon. the Viscount Burnham will speak at the opening dinner. Papers are to be given on various problems affecting the collection and distribution of information by experts, including Dr. de Vos Van Steenwijk, of the League of Nations, and Mr. Kaiser, of the Engineering Societies' Library (New York), who will speak on "Systematic Indexing."

The Conference is open to all interested; as accommodation is strictly limited, those wishing to attend should communicate without delay with the Secretary of the Association at 38, Bloomsbury Square, W.C.1.

Engineering Education.

Sir Isaac Pitman & Sons, Limited, of Parker Street, Kingsway, London, W.C.2, are publishing a serial publication entitled "The Engineering Educator," to be issued in 30 fortnightly parts. It is to be edited by Mr. W. J. Kearton, M.Eng. Each part will consist of 48 pages ($9\frac{3}{4} \times 7\frac{1}{2}$) and a frontispiece, and will cost 1s. 3d. net. Amongst the contributors are Sir Robert Hadfield; Professors Gibson, Goodman, Watkinson and Lea; Messrs. Patchell, Mitchell and Swinburne. Pattern making, moulding and foundry practice in general is to receive a generous section.

The Comparison of the Size and Distribution of Graphite in Cast Iron.

BY OUR METALLURGICAL CORRESPONDENT.

Whatever property of grey cast iron is under review, whether it be a mechanical, electrical, magnetic or some other physical property, reference invariably has to be made to the size and distribution of the free graphite. It is hardly too much to say that every research into the properties of grey cast iron contains a reference to the free graphite of this nature. Many illustrations and instances of such references can be quoted from recent researches, and they generally accompany some attempt to explain the influence of some addition to, or some modification in the manner of preparation of, the cast iron, on the various mechanical or physical properties. The beneficial influence alleged to accrue from certain alloy-additions to cast iron has been explained as being due to their influence on the size and distribution of the graphite. Steel mixture irons or semi-steels have been accounted improved irons on the grounds of a finer and better distribution of the graphite due to steel additions. Such statements are rarely, if ever, accompanied by strict proof, and the statement that a finer and better graphite structure exists is usually the bald statement of the investigator's personal observation. Frequently the bald statement is accompanied by an illustration of the graphite structure observed, but the actual comparative evidence is left to the reader, and is very often complicated by the lack of strictly accurate data of the magnification of the structure presented. It is very rare to find a series of accurate comparative photographs to demonstrate the alteration in graphite size and distribution observed in a particular investigation.

Attempts to compare the graphite structure by measurements of the area occupied by the graphite have been made (*vide* Hailstone, J.I.S.I., 1916. C.S.M.). Such measurements are extremely laborious to undertake, and are liable to so many sources of error as to make their value extremely doubtful. In addition, such measurements are concerned with the size of the graphite only and not its manner of distribution. One of the principal sources of error in such measurements arises from the method of preparing the specimens for examination. Extremely careful polishing is necessary at all stages in order to prevent the distortion and disintegration of the bounding edges of the graphite plates. This difficulty has been ingeniously illustrated by Logan ("F.T.J.," February 19, 1925. Page 159).

By constructing "synthetic graphite structures" containing definite percentages of the area of the visible field occupied by graphite and comparing these with actual photomicrographs, it was shown that the actual photographs apparently contained more graphite than the comparative "synthetic structures." This was ascribed as being largely due to the disintegration and extension of the bounding edges of the graphite as a result of polishing and preparing the specimens. Logan appreciated the fact that this was only a partial explanation of the apparent difference in the amount of graphite revealed in microstructures of specimens known to contain the same amount of graphite. In this connection it should be remembered that a microstructure is a section in one plane only of the specimen, and, as such, is not a true guide to the volume percentage of the graphite present. The apparent graphite percentage present as revealed by the microstructure depends very largely on the disposition of the graphite plates relative to the angle of the plane along which the specimen has been cut and polished. This is an additional source of error likely to arise in measurements of the area of the graphite revealed in microstructures. In any case it is necessary to emphasise the importance of the careful preparation of the specimens for examination in the comparison of the graphite structures.

For general purposes the most satisfactory method of comparing the size and distribution of the graphite in different specimens is the use of comparative microstructures carefully prepared under comparative and standard conditions. A similar method has been proposed in the comparison of the grain size in the structures of annealed brasses. O. W. Ellis (J. Inst. of Metals, 1917, No. 2) has constructed a special arrangement of a series of standard photographs of annealed brasses for this purpose in the form of a comparison screen.

Under ordinary industrial conditions investigations which necessitate the production of comparative conditions are never easy, and to eliminate the necessity of this, the preparation of a series of comparative standard photographs of graphite size and distortion could be undertaken by an authoritative body such as the British Cast Iron Research Association. There are a variety of ways in which such a series could be prepared. For example, a standard series of pig-irons might be used, or a series of test bars of thicknesses varying from the thinnest of light castings up to some predetermined maximum might be adopted. The use of a wedge-shaped specimen of the type suggested by F. J. Cook (J. Staff. Iron and Steel Inst., 1909-1910) might be resorted to as a means of obtaining a standard set of specimens of varying graphite size and distribution.

It would be a distinct advantage if such a series of standard photographs were to include some in which the graphite structure was related to the mechanical strength properties, and in this case, more particularly than any other, any attempt to do this should be undertaken by an authoritative body such as the above-mentioned. The series of standard photographs might contain examples of very fine, fine, medium and coarse distribution of the graphite at, say, 50, 100 and 500 diameters magnification. The series might include several specimens at similar magnifications taken from high-grade irons of various known strength properties. A series of such standard photographs prepared in an authoritative manner would form an invaluable standard of reference and would be extremely useful to foundrymen, metallurgists and engineers for comparison purposes. The ability to compare a given graphite structure with, shall we say, B.C.I.R.A. photograph No. X, would enable comparative statements relating to graphite structures to be made of much more value than the meaningless statements which are so common.

[Unfortunately this does not prevent the investigator from publishing pin-point microphotographs which may not be representative of the general field under investigation.—EDITOR.]

Applications for Trade Marks.

The following applications to register trade marks are extracted from the "Trade Marks Journal":—

"N. H." ON A DIAMOND.—Gunmetal and cast-iron valves and cocks. Newman, Hender & Company, Limited, Dyehouse Works, Woodchester, Gloucestershire.

"GALLAS."—Furnace cements. The General Refractories Company, Limited, Kelham Island Firebrick Works, Alma Street, Sheffield.

"SIEMENS 'FURNACE' STEEL," AND DESIGN.—Basic open-hearth Siemen's steel. Stewarts & Lloyds, Limited, 41, Oswald Street, Glasgow.

Brightside Foundry and Engineering Company, Limited.—MR. F. W. FIRTH, presiding at the 27th annual meeting, at the Wicker Iron Works, on August 30, said that during the year a policy of concentration had been decided upon. In these abnormal times standing charges, to say nothing of rates, made the manufacturer's lot an extremely difficult one. They had taken the opportunity of selling the Wicker Works, and the engineering department would be carried on at Ecclesfield. It would be necessary to transfer the registered offices of the company to the Newhall Works, and it was hoped to have the staff installed there in a very short time. A matter that gave a good deal of thought was the decision to close down the Carbrook Foundry. They found they could help themselves by saving a good deal, and putting it into Newhall, where there was plenty of room. That was effected in the first week of July, and it had turned out very satisfactory. The directors, said the chairman, were quite convinced that these alterations would effect a considerable saving. Certainly, the customers would not suffer; rather the efficiency would be greater.

The Detroit Foundrymen's Convention.

Last Saturday the British delegation to the second International Foundrymen's Convention, to be held from September 27 to October 1 at Detroit, left Southampton by the "Lancastria." The boat—which came from Le Havre, already contained a number of French, Italian, Belgian, and a Spanish delegate—was two hours late in arriving. However, this did not prevent the Mayor of Southampton (Mr. Silverman), the Deputy Mayor, and Councillor Fittes being on board to greet the delegates. This charming little ceremony was staged in the Palm Lounge. Mr. Vincent Delport, the European representative of the American Foundrymen's Association, took the chair, and, in calling on the Mayor, expressed the gratitude of European foundrymen to his Worship for his kindness in coming along to welcome the non-British delegates to the "Lancastria," which, after all, was a bit of British territory, and to ask the whole delegation to carry to America the good wishes of the town of Southampton.

The Mayor said that he was only too delighted to be present, as the town of Southampton, being so intimately connected with international trade and conventions of the type which was being staged at Detroit, was of such a character that business of benefit to this country was bound to result. The main object, as he understood it, was for mutual study of technical questions, and the preparation of international standards, which obviously makes international trading much simpler. On behalf of his colleagues and himself he wished the delegates a good crossing, and a pleasant and profitable time on the other side.

Mr. V. C. Faulkner (president of the Institute of British Foundrymen), on rising, said he had a double duty to perform. Primarily he would take the opportunity of asking the delegates to pass to his Worship and his colleagues a hearty vote of thanks for their kindness for according them an official send-off, and, secondly, on behalf of the officers, Council, and members of the Institute, he brought their wishes for a pleasant and profitable trip. He regretted most sincerely that the present industrial crisis had prevented his travelling with the delegates, but he was convinced that the Institute would be excellently represented by Mr. John Cameron, its Past-President, and Mr. S. H. Russell, its Vice-President. He was pleased to see his friends, Mr. Ropsy and Mr. Vansetti, the Presidents of the Belgian and Italian Associations, were present, and felicitated the latter on the escape which his personal friend and Prime Minister, Signor Mussolini, had had that morning. Finally, he hoped that every one would derive a substantial benefit from the trip they were taking.

Mr. John Cameron, in seconding, emphasised the gratitude which the foundry industry felt for the encouraging address which his Worship had delivered.

Mr. Magdelenat, a Vice-President of the French Association, speaking in French, said that the official send-off accorded by Southampton had made him feel that the Convention had already started. Foundry problems had been discussed in the train between Paris and Havre, and he felt sure that the success of the Congress was already assured. After a brief reply by the Mayor, the Chairman said that one of the objects of the Convention was to get an acquaintance with each other's viewpoint. In America, where labour was so expensive, the question of transport was of paramount interest, whilst for Italy, where labour was comparatively cheap and plant so expensive, the problem, though important, was not so pressing. On behalf of the American Foundrymen's Association, he promised them that no stone would be left unturned to see that each one had a real good time. He thanked all those who had helped him to organise the European delegation, especially Mr. Faulkner, Mr. Ronceray, Signor Vansetti, and Dr. Geilenkirchen. Finally, he asked them to address all their inquiries to Mr. Baker, of Cook's Tourist Agency, who would accompany them throughout the tour.

The British Delegation consists of Mr. John Cameron, of Cameron & Roberton, Kirkintilloch, N.B. (immediate past president of the Institute of British Foundrymen); Mr. S. H. Russell, of S. Russell & Sons, Leicester (vice-president of the Institute of British Foundrymen); Mr. H. Winterton, of Wm. Cummings, Limited, Glasgow (vice-president of the Foundry Trades Equipment & Supply Association); Mr. John Shaw, the Brightside Foundry Company, Sheffield; Mr. F. Russell, of the General Refractories Company, Sheffield (past president of the Refractories Association); Mr. W. B. Lake, of Lake & Elliott, Braintree; Mr. T. H. Gray, of Thos. E. Gray & Sons, Limited, London; Mr. W. Jolley, of the Metropolitan-Vickers Electrical Manufacturing Company, Trafford Park; Mr. J. A. E. Wells, of Edgar Allen & Company, Limited, Sheffield; Mr. E. Longden, of John Hetherington & Sons, Limited, Manchester; Mr. A. Firth, of the Brightside Foundry Company; Mr. J. H. Booth, of Barford & Perkins, Limited, Peterborough; Mr. A. H. Ryner, of International Processes, Limited; Mr. F. Blackwell, of the Diamond Foundry, Luton; Mr. J. M. Primrose, of the Grangemouth Iron Company, Limited, Falkirk; Mr. H. D. Campbell, of Shaw's Foundry, Glasgow. Messrs. Cameron, F. Russell, Longden, Winterton, and Campbell are being accompanied by their wives. Prominent amongst the French delegation are Messieurs Ronceray, Magdelenat, and Coquenot. The Italian delegation is quite a large one, and is headed by Sig. Com. Ing. Vansetti, of the Milan Steel Foundry Company. Belgium has three delegates, which includes the president, Monsieur Paul Ropsy. The largest delegation is the German one. It includes Dr. Geilenkirchen and Prof. Piwowarsky. Holland, Spain, Switzerland, and Sweden are also to be represented.

The Note-Book.

By JAMES EDGAR.

How many engineers keep a commonplace book? The number is not many. The writer, in a varied experience of drawing offices and workshops, has met very few men who have taken the trouble to make notes even of unique jobs. There is altogether too great a reliance on memory. A good memory is valuable, but there is no possible reason why it should be burdened with details that could be more accurately stored in a note-book. Further, when a really intricate and difficult piece of work has been carried through there are many little points which are very important, but may be quite forgotten, and the value of the experience for future guidance is very much reduced. The habit of making notes should be cultivated also by craftsmen; many valuable points passed on by hand never see print, and are apt to be forgotten in time.

In student days it is the invariable custom to make voluminous notes, either when or immediately after the lecturer has finished speaking, and it is surely as important that notes should be taken on practical work, as it is always easier to trace abstract subjects through text-books. Many men refer to their class note-books for years after they are written to help them in elucidating difficult problems.

The engineer's or mechanic's note-book must of necessity include many sketches. A simple sketch and a few lines are all that is required as a rule. It is surprising how quickly a glance at a rough sketch brings back all the essential facts of a job.

Akin to note-taking is the practice of keeping cuttings from technical Journals. Space or other consideration may prevent periodicals being bound, but articles can be filed in order that they can be referred to at a future date. Quite an encyclopædia of technical information can be built up in this way.

It is surprising the amount of knowledge we wantonly let slip from us in a short time. One use of the commonplace book may be mentioned in conclusion. It is very common now for foremen to quote prices of jobs; in fact, some of the departments have to compete with outside firms. The foreman who has to do this finds his note-book invaluable, especially if he takes particulars of time and quantity of material.

Bronze Worm Gear Blanks Produced by Centrifugal Casting.*

By Francis W. Rowe, B.Sc.

(*Continued from page* 219.)

Chill-Casting.

Up to the development of the centrifugal process, which will be described later, the author's firm had for many years cast worm-wheel blanks with a cast-iron chill embodied in the mould to chill the periphery of the wheel. This resulted in a blank with varying properties from outside to interior.

The thickness of the cast-iron segmental chill was varied for different types of wheels to secure a chilling effect which would extend to just below the roots of the teeth in the finished article. By this means rapid solidification was assured in the vital part of the wheel, and this resulted in increased density and hardness in these portions.

Unfortunately, the use of a single ring chill, such as described above, often resulted in a type of structure which was not the best of which the alloy was capable. The differential rate of solidification and peculiar rate of cooling resulted in the α-solid solution containing more tin in the chilled than in the unchilled portions, and consequently less α-δ eutectoid was present in the chilled portion. This is shown in Figs. 5 and 6. This effect is also visible in the fracture, the chilled portion having a reddish-brown fracture and the unchilled a grey fracture consistent with a normally cooled sand-casting of that tin content.

It was found that this undesirable feature could be eliminated by using a heavier chill, when the structure in the chilled portion became that of a completely chilled phosphor-bronze. This deep chilling from the outside only gave wheels

FIG. 4.—SECTION OF BRONZE WORM WHEEL BLANK CAST WITH RING CHILL ON PERIPHERY. × 1.8.

FIG. 5.—SAME AS FIG. 4. CHILLED PORTION. × 200.

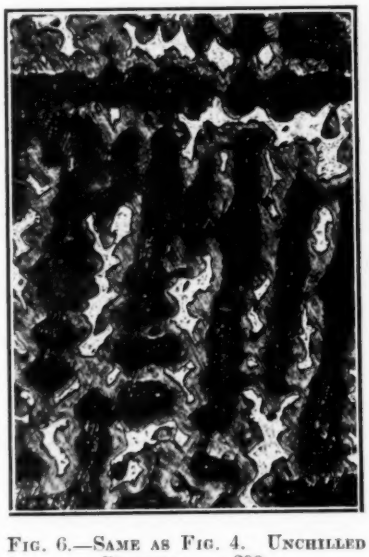


FIG. 6.—SAME AS FIG. 4. UNCHILLED PORTION. × 200.

FIG. 7.—SECTION OF DIE-CAST BRONZE WORM WHEEL BLANK. × 1.8.

NOTE.—Etched with $(NH_4)HO$ and H_2O_2, and afterwards with Fe_2Cl_6.

* A Paper read before the Liege meeting of the Institute of Metals, the author is Metallurgist to Messrs. David Brown & Sons (Huddersfield), Ltd., Huddersfield.

which were generally too brittle except for very strong designs.

As will be seen from the macrograph in Fig. 4, the grains in the chilled portion are radial, starting from the outside edge. In the portion which is unchilled, they are of heterogeneous orientation. When the chill is sufficiently heavy to penetrate the entire wheel, the radial crystals persist right through the blank, resulting in potential radial cleavage planes. Thus the depth of chill used was regulated by compromise. Heavy wheels of strong design permitted of a deeper chill, and thus a more desirable structure. With lighter and more delicate wheels, the lower α-δ eutectoid content in the chilled portion had to be accepted. The results obtained in service showed that the advantages accruing from increased hardness and density over those of a sand-cast wheel outbalanced the disadvantage of decreased α-δ eutectoid in the working portions. Ring chill casting by such methods as those described above is not without difficulties from a foundry point of view. It is, of course, essential that the moulds be dried to prevent moisture accumulating on the segmental chills, and the greatest care has to be exercised in fixing the casting temperature and size of runners for different types of wheels.

The advantage is in the fact that one can always be certain of the tooth portion of the wheel being really dense and sound except at the point where the runner enters, at which spot porous places may be found unless the section of the runner is correct. Unfortunately, the soundness of the teeth may be achieved at the expense of the soundness of the interior portion, particularly if uneven sections exist here. Microscopic porosity is not serious in this portion of the wheel, but knowledge of the likelihood of small defects in this portion often renders lightening of the design unsafe.

FIG. 8.—SAME AS FIG. 7. SHOWING LONG PRONOUNCED DENDRITES. × 100.

FIG. 9.—SAME AS FIG. 8. SHOWING DISTRIBUTION AND SIZE OF α-δ EUTECTOID. × 200.

FIG. 10.—SECTION OF CENTRIFUGALLY CAST BRONZE WORM WHEEL BLANK. × 1.8.

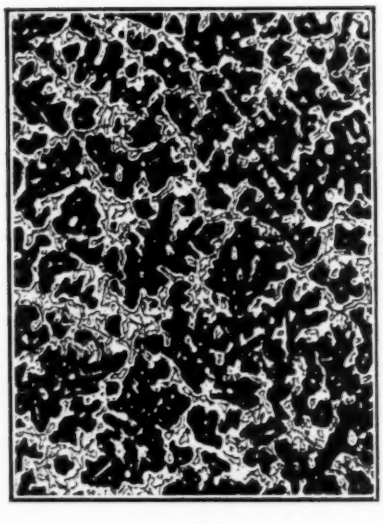


FIG. 11.—SAME AS FIG. 10. SHOWING SHORT HETEROGENEOUSLY ORIENTATED DENDRITES. × 100.

NOTE.—All sections were etched with $(NH_4)HO$ and H_2O_2, and afterwards with Fe_2Cl_6, with the exception of Fig. 8 in which Fe_2Cl_6 was omitted.

Die-Casting.

Bronzes and phosphor-bronzes are not generally considered as being easy to die-cast. The most usually employed high melting-point alloy for die-casting is "aluminium bronze." Experimental work has shown, however, that die-casting in such alloys is quite possible for worm-wheel blanks if a sand core is used to form the interior. The chief difficulties lie in obtaining castings free from drawn places. The rapid solidification which takes place unless the dies are preheated to a high temperature results in shrinkage cavities and porosity. For worm-wheel blanks,

the best results have been obtained by having a central core of sand and forming the runners in this core, the metal being poured down a vertical hole in the centre of the core. A high pressure head of metal is necessary to ensure good feeding of the interior portions of the casting. Unfortunately, the high mould temperature and casting temperature which it is necessary to employ to ensure a high proportion of good castings result in a large grain-size and a very pronounced dendritic structure. These features are illustrated in Figs. 7 and 8 and Fig. 9. The separation and distribution of the α-δ eutectoid are very good. The physical properties of material cast in this manner are shown in Table III. It will be seen that these are generally slightly superior to those obtained by methods previously described.

Centrifugal Casting.

As the worm-wheel blanks are circular in form, it was a logical step that attention should be turned to the possibilities of producing blanks by centrifugal casting. The first steps were directed towards ascertaining what improvement, if any, in physical properties could be obtained by centrifugal casting, before proceeding to the more important work of putting the process on a commercial basis.

The mould used is of steel, and consists of a flat bottom plate on which the top half rests and is held by cams. The top half has a central orifice down which the metal is poured. The centrifugal casting machine is arranged to spin the mould about its vertical axis. In practice, the driving mechanism is below floor level, and the bottom plate of the steel mould is bolted to a coupling on the vertical shaft. The shaft is driven through a cone clutch and gearing by a variable speed motor. The hollow core which forms the interior of the blank is set in a "print" in the bottom half of the steel mould, the top placed on, and the cams rotated to lock it in position. The metal is poured into the central orifice in the mould and flows into the centre of the core, from which it is flung out to the walls of the mould through suitable runners cut in the core.

A special refractory material is used for the cores, as with the ordinary sand cores there is a great danger of these bursting under the high pressures and mould speeds. The moulds at present being used are made from alloy steel forgings suitably forged and heat-treated before final machining to give minimum distortion in service.

The speed of rotation is governed by the size and section of the gears being cast, and is varied to give the minimum grain-size in the casting. The speed of rotation is designed to give a minimum pressure on the walls of the mould of 45 lbs. per sq. in., and varies from 450 to 950 revolutions per minute. The moulds are brought up to full speed before commencement of pouring, which is done in the ordinary manner from plumbago crucibles suspended from a central runway. A sheet metal guard with the necessary orifice for pouring the metal shields the whole mould during casting operations. This is essential, as at the high speed of rotation any metal splashings are flung out with great force.

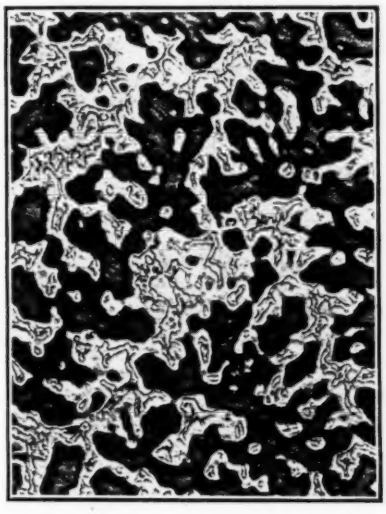


FIG. 12.—SAME AS FIG. 10. SHOWING DISTRIBUTION AND SIZE OF α-δ EUTECTOID. × 200.

NOTE.—Etched with $(NH_4)HO$ and H_2O_2, and afterwards with Fe_2Cl_6.

As the period of solidification is very short, it is necessary to use a high casting temperature, varying from 1,230 to 1,320 deg. C., according to the size of the wheel. This is done in order to secure a sufficiently long period of solidification to ensure full automatic feeding of the metal by the centrifugal force. It is this automatic feeding which constitutes one of the big advantages of the process over stationary die-casting. Actually the moulds are spun for 30 seconds to 4 minutes after pouring, depending on the size of the wheel. The clutch is then thrown out, and the top half of the mould lifted off. The taper and design of the moulds are so arranged that no difficulty is experienced in ejecting the spun castings by the special tackle employed. The moulds are coated

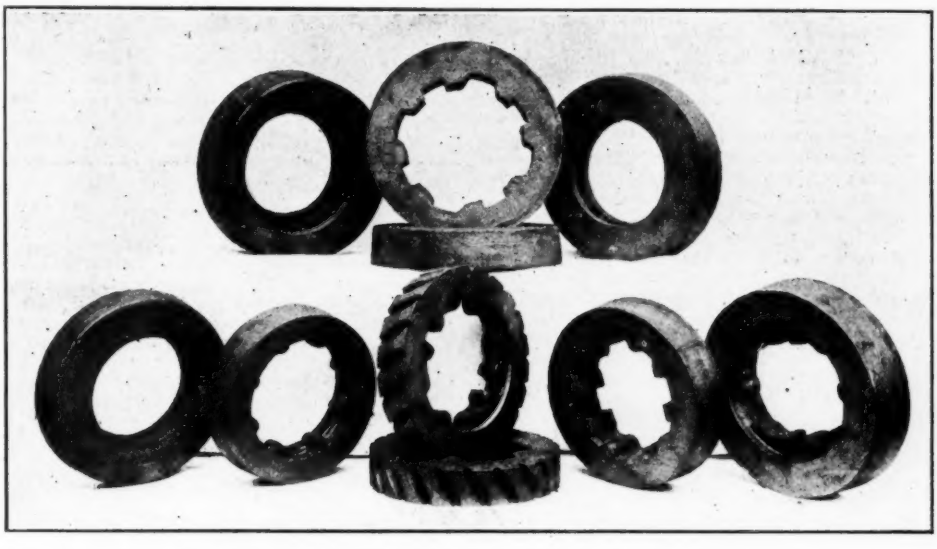


FIG. 13.—GROUP OF TYPICAL BRONZE WORM-WHEEL BLANKS CAST BY THE CENTRIFUGAL PROCESS.

with a thin layer of refractory material mixed with carbonaceous matter to prevent sticking.

The physical characteristics of the wheels cast in this manner are summarised in Table III. The figures given represent the average of five recent tests. It will be noticed that an all-round improvement in physical properties results from this mode of casting, although the density and hardness are not a great deal higher than those which obtain in a die-casting. Microscopic examination, however, reveals the essential difference between the structure of the centrifugal casting and that of a die-casting.

Fig. 10 shows the typical microscopic appearance of wheels cast in this manner; the grain-size is extremely small. This small grain-size results in short compact dendrites heterogeneously orientated, as shown in Fig. 11. Fig. 12 shows the α-δ eutectoid in small particles evenly distributed. Provided that a sufficiently high speed of rotation is maintained, this small grain-size appears to be very little affected by the casting temperature and the temperature of the moulds. Naturally some increase in grain-size obtains when the mould temperature reaches 400 deg. C. and the casting temperature is on the high side, but the variations due to these causes are much less than occur with any other method of casting. In fact, one of the attractions of the process is the small variation which is shown in structure and strength between wheel blanks of widely varying sections. In practice, a multiplicity of moulds are used, so that the maximum mould temperature reached is approximately 200 deg. C. This facilitates assembly of the moulds, and at the same time prevents an unnecessarily long period of solidification. No life figures have yet been obtained for the special steel moulds at present used, but there is every indication that these will last upwards of 4,000 castings each.

At the present time the smallest wheels being cast have a diameter of 6 in. and weigh 26 lb., whilst the largest have a diameter of 22 in. and weigh 195 lb. Fig. 13 shows a group of centrifugally cast blanks unmachined, and will give an idea of the variety of size and shape being produced. The two wheels in the front centre have had the teeth rough cast in. This is a recent addition which is being actively pursued. It should be mentioned, however, that up to the present no material improvement in metallurgical properties has resulted from casting in the teeth, but the subsequent machining time is, of course, materially reduced.

Fig. 14 shows a group of finished worm-wheels which have been cast by the centrifugal method.

As to the extent to which this process has been exploited in practice, the author would state that up to the date of writing over 4,500 castings have been made, with an average weight of approximately 85 lbs.—the total weight being over 170 tons. The value of the castings is nearly £30,000. It is quite probable, however, that these totals will have been doubled by the time this Paper is published. Many of the early wheels have been in service for over three years, so far with very excellent results. Actual comparative service results will take some time to obtain, as the life of a chilled-cast wheel is from 140,000 to 300,000 miles, depending on the design and loading conditions. As very few vehicles do more than 30,000 miles per annum, it will be seen that the life is from 4 to 10 years.

In conclusion, the author would like to express his thanks to the directors of Messrs. David Brown & Sons (Huddersfield), Limited, for permission to publish this Paper, the whole of the data for which was obtained in their research department and bronze foundries. He would also like to record his appreciation of their steady faith in the ultimate success of the centrifugal process, now happily achieved, despite the many costly difficulties that were encountered in the early stages of its development.

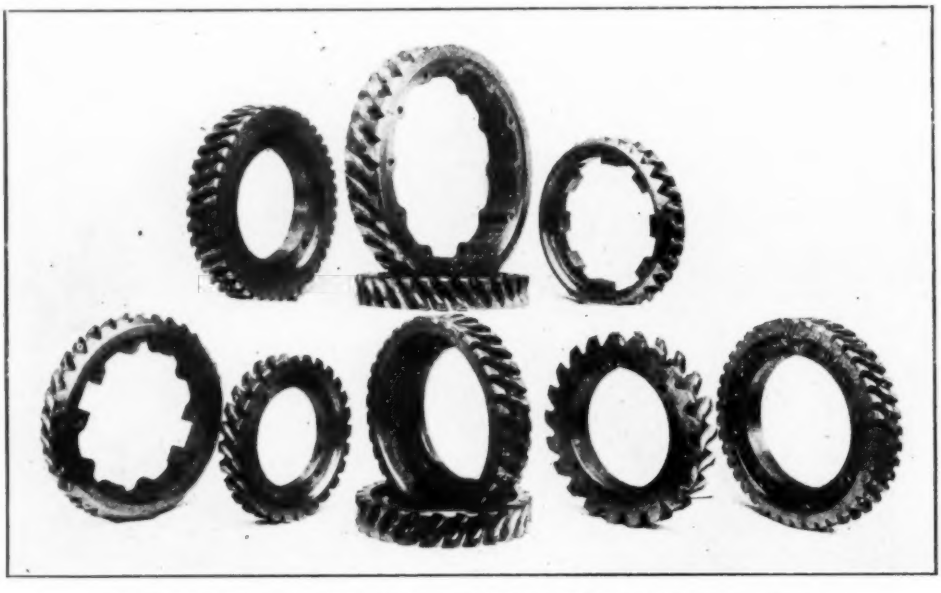


FIG. 14.—GROUP OF TYPICAL BRONZE WORM WHEELS MACHINED FROM BLANKS CAST BY THE CENTRIFUGAL PROCESS.

Annual Report of the Government Laboratory.—The annual report just issued on the work of the Government Laboratory contains reports of analyses, often of an unusual nature, made by the Government Chemist during the year 1925-1926. Copies (price 1s. 6d. net, post free 1s. 6½d.) may be obtained from the Stationery Office, Kingsway, London, W.C.2.

The Royal Metal Trades' Pension and Benevolent Society.—This Society will hold its 78th anniversary festival dinner in aid of the charity at the Guildhall, London, E.C.2, on Tuesday, November 2, next, at 7.15, for 7.45 p.m. H.R.H. the Prince of Wales will be present, and the Lord Mayor of London will be in the chair. Dinner tickets can be obtained from the Secretary, 195, Upper Thames Street, London, E.C.4.

Analysed Samples for Students.—For some time the organisers of the British chemical standards movement have been asked to provide carefully analysed metallurgical samples at an appreciably cheaper rate than the well-known British chemical standards, in order to meet the need of college students, works laboratory apprentices, and others requiring materials on which to practice analysis. In response to this demand, Messrs. C. H. & N. D. Ridsdale, of Middlesbrough, have recently prepared such cheap samples in a form ready for analysis, from suitably selected materials. Each of the samples has been analysed in duplicate by two qualified chemists, and concurrent tests have also been made with British Chemical, U.S. Bureau or other suitable standard samples of the nearest type.

The Application of Payment by Results to the Foundry Industry.

By J. W. Kearsey.

(*Continued from page* 228.)

Furnace Attendants.

This term includes cupola men, firemen, mates, helpers, etc. The results of placing this category of labour under some system of payment by results will prove highly satisfactory. The task, particularly in an iron foundry, is in some ways easier than that of maintaining schemes for other classes of foundry labour. The plan of procedure calls for the consideration of existing conditions, available plant, amount of labour, etc., the fixing of a fair average output in some convenient terms of measurement, and the arrangement of a scale of bonus payment on all output in excess of this standard.

The bonus system must necessarily take the collective form, and, consequently, is subject to the following contingencies:—(1) That provision is made for any adjustments necessitated to compensate for any improvements, or otherwise, in basic conditions of operation; (2) that a reasonably consistent output can be maintained, bearing in mind the existing number of employees; (3) that provision is made for adjustment of the output standard if either the number of employees is varied, or their working hours altered through any deviation from conditions on which the bonus standard was computed; and (4) that due attention be paid to the possibility of some portion of the plant being temporarily idle, and that arrangements be made to meet such an occurrence by a transient adjustment in the output standard.

In an iron foundry, the task will assume fairly simple proportions, for both the character of the metal itself and of the melting facilities will not appreciably vary. It will not be difficult to determine the daily or weekly amount of metal that can be melted by the cupola, or cupolas, and to fix from this information the basic bonus standard. A certain bonus price per ton will be paid on all metal melted over and above this amount, and the total bonus earned will be divided up between the cupola men and their helpers. On the other hand, several complexities arise when dealing with non-ferrous foundries, and which render the fixing of bonus standards rather more difficult. A variety of metals of considerably diverse melting points are handled. The melting times of copper-base and of aluminium-base alloys are dissimilar, and are not totally compensated for by their corresponding specific gravities when examining output on a weight basis. Also, there may be several different types of melting furnaces in use, varying in method of firing, capacity, and mechanical operation. These points complicate the question of bonus in so far as they will necessitate the calculation of output and the fixing of bonus standards in rather a more detailed manner than that used for iron foundries.

The standard output must be expressed in terms of points. A scale of points to be awarded for the various capacity melts, carried out by each different type of furnace, must be drawn up. It will be usually sufficient to assess points for two kinds of alloys only, viz., copper-base and aluminium-base alloys. The scale will not slide on a weight basis for this reason: where it is possible for a fireman to get four 200-lb. melts from a pit fire, it must not be assumed that he may equally perform eight 100-lb. melts. The next step will be to consider the furnaces, and their labour attendance, in order to determine a standard of output, expressed in points, that can be utilised for the purpose of calculating bonus payment. The actual output, for the week or whatever other period of time may be used, is also reduced to points for comparison purposes, and the amount of bonus will depend on the number of points earned in excess of standard, a definite monetary value per point having been previously decided when fixing the output standard. The bonus will be divided up amongst the firemen and their mates, the apportionment being preferably based on their wage rates and hours worked.

Labourers.

It is impossible to remunerate labourers on any basis which has *direct* relation to either their collective or individual efforts. Yet it is possible to pay them a form of bonus or efficiency money, which will vary according to any increase or decrease in the production results of the particular group of men upon whose output the relative amount of their efforts will have either a favourable or adverse effect. For it will be recognised that the output of men, on definite production work, is largely governed by the efficiency and willingness of their supply labourers and helpers. Thus the bonus payment of indirect labour will depend on the earnings of the production men with whom they are associated.

Provided that three conditions are constant, *e.g.*, that their individual duties remain fairly uniform, their numbers fluctuate proportionally with production men, and that individuals may be definitely attached to certain groups of men on output, a very simple system of computing their bonus can be evolved. That is, to pay them a certain percentage on their hourly rates which bears a definite ratio to the percentage earned by the production men that they serve. It will be noted that the percentage need not necessarily be the same but must merely fluctuate in the same relationship.

Unfortunately these three contingent stipulations cannot always be met, and consequently some arrangements must be made to adjust for alteration in conditions of operation from normal. For example, one must arrange so that as the number of bonus hours worked by production men rises or falls below normal, so the percentage bonus factor for indirect labour rises or falls in a similar ratio.

Suppose a labourer serves six moulders, and that he receives a percentage on his hourly rate, as bonus, equal to the average percentage earned by all his moulders, working full bonus-time. If they work a complete 47-hour week entirely on bonus, earning an average of 30 per cent. on his time rate, the labourer will also receive 30 per cent. on his time rate as bonus remuneration.

When they have an average of 35 hours in a week on bonus, although working the full week, and earn an average of 25 per cent. on the actual bonus hours, the labourer will receive $\frac{25 \times 35}{47}$ or 18.6 per cent. on his total wages for the week.

This simple example explains the broad principle of bonusing indirect labour. Other factors of calculation for stabilising payment may also be introduced, but the only essentials are those indicated. Alteration in the number of men served, short time, etc., can be met in an exactly similar manner to that outlined.

Supervisory Staff.

There does not seem to be any logical reason why foremen should be excluded from participation in bonus remuneration. The only objection that can be raised is the difficulty of devising a suitable basis of payment. That corresponding benefits will be derived must be undisputed for there can be no denial that every individual worthy of his job responds to an immediate financial incentive. From the idealistic view point, supervisory bonus would be based on a variety of factors, of which quantity of output would not necessarily be the principal: such factors as quality of output, amount of defective work, elimination of waste, etc., would bear considerable influence. But the subject is being dealt with from an essentially practical aspect and therefore it must be governed by simplicity. It is proposed to portray a means whereby supervisory bonus can be calculated on a basis which shall take into account as many indications of a foreman's activity and efficiency as possible.

XUM

Methods can be outlined only, for details of application will depend upon the extent of functions of foremen in the particular foundry and also will vary slightly for the different supervisory grades. The method here delineated is suitable for foremen in direct charge of shops and can be altered, where necessary, to meet any special circumstances for general foremen or charge hands.

After examining the functions of foremanship and considering the various factors affecting their efficient operation, one can decide that the following influence must be catered for when fixing any form of supervisory bonus remuneration:—(1) A measure of efficiency of the total output, assuming that the shop is fully employed on bonus work, contains the normal complement of men, and that all other conditions of production are average; (2) the proportion of the shop that is employed on bonus work, expressed in hours of production bonus work against total hours of production work, inclusive of time and bonus; and, (3) whether the complement of men employed is in excess, or otherwise, of the number fixed as normal for the shop.

If a shop is entirely on bonus work, the proportion that the total production bonus earned bears to the sum of production wages will be a good reflex of its output efficiency. Therefore, to fulfil the first condition, this percentage will be very suitable as a basis of calculations for supervisory bonus from the aspect of output alone.

The second point concerns the number of bonus-hours worked. When the shop is working only partially on bonus, adjustments must be made to the foreman's bonus. On the assumption that his extra remuneration amounted to 40 per cent. on his wage, calculated from the average percentage bonus paid to his men, then this amount should vary with the number of men actually on bonus. In its extreme form, suppose one man only to be on bonus and that he earns 50 per cent. on his job, then it would be ridiculous to pay the foreman 50 per cent. on his weekly wage. Obviously this payment must be contingent on the shop being fully engaged on bonus output.

The third point is very similar. If the number of men falls below the normal, the forman is not entitled to the same amount of bonus payment as if conditions were standard. On the contrary, if the shop is busy extra men will be engaged; his duties then become more onerous and it is equitable that his bonus should be increased.

To summarise, the aim is to frame a system of bonus remuneration whereby the foreman's bonus bears the same percentage to his wage as a similar average, taken over the earnings of all his men, under average conditions, viz., when the shop is working with normal personnel on full-time bonus. When his shop gets busier and employs more men, then his bonus percentage must be higher than the shop average. When his shop is slack, and employment falls, so his bonus will be lower than the shop average.

The second and third factors* may be combined for the purpose of facilitating bonus adjustment. The basic number of production bonus-hours for the shop will be the normal number of men employed multiplied by the number of hours in the working week. This standard figure will be compared with the actual production hours worked on bonus, and a percentage of bonus activity deducted from following formula:—

$$\text{Bonus activity} = \frac{\text{actual production hours worked on bonus}}{\text{standard production hours on bonus.}}$$

But this bonus activity percentage will, in practice, prove too drastic in its effects to incorporate unaltered in a formula for bonus calculation. Consequently, the adoption of a scale, somewhat as follows, is recommended:—

Bonus activity.	Factor for use in bonus computation.
50% below normal ..	0.75
Normal	0.1
50% above normal ..	1.25
100% above normal ..	1.5

* These factors are obtained by reducing the difference between the actual Bonus Activity and normal by one half, and adding to or subtracting from unity as the case may be.

By this means, a bonus computation factor can be worked out for any percentage of bonus activity. Now we have arrived at the final stage and can state a definite formula for calculating supervisory bonus:

The foreman's weekly wage multiplied by the average percentage bonus of his men multiplied by the bonus activity factor of his shop.

Although this plan is neither entirely comprehensive nor ideal, it does offer a practical solution of the supervisory bonus problem, accounting for the main difficulties in a satisfactory, yet simple, manner.

Treatment of Defective Work.

Although it may be reduced to a minimum, defective work can never be eliminated. For the purpose of bonus calculations, the only question to consider is whether the loss shall be borne by the worker or the firm. Obviously, bonus will not be paid for work rejected owing to faults traceable to the worker. Equally, he must not be penalised for the production of work which proves defective owing to circumstances over which he has no control. The corollary is the unprejudiced inspection of each defective unit of output for the purpose of definitely allocating the cause to a definite source. Whether the blame shall be borne by the worker or not will be solved by this examination.

Great care must be exercised in the inspection of defective work. Nothing proves more demoralising in its effects on the man's morale than distrust engendered by the suspicion that he is being unjustly deprived of the due fruits of his efforts. Proof of his culpability must be above doubt. When the problem is definitely open, the operative must be given the benefit. When there is uncertainty, the loss must be shared on an equal basis.

Systematic inspection of work, even in the smallest of foundries, is essential. By whom the function is performed will be immaterial. Where size permits, an official inspector is best employed; his value will many times exceed his cost. The detection of "wasters" in their early stages is a considerable factor in the elimination of waste.

Three courses are open for the penalisation of the producer of defective work: (*a*) Replacement in his own time; (*b*) rectification in his own time, and (*c*) deduction of its value from his earnings. Each course has merits which recommend it to peculiar circumstances.

The conditions attending replacement and rectification must not be misconstrued. This work will not be carried out and paid for at ordinary time rates; on the contrary, the time spent is deducted from the time allowed on other bonus work. These methods will, in practice, only apply when the defect has been discovered subsequent to the payment of bonus to the man held to be culpable. Neither procedure is universally adaptable.

The third course is more generally suitable. If the defect is discovered, and the cause of reject determined before bonus payment on the particular work is made, the man does not receive the benefit of its credit. If the defect is apparent only after payment has been made for its production, a deduction must be made, to the amount of half of its standard bonus time at his hourly rate, from his bonus earnings for the current week. In the case of any rectification being necessary, and which he cannot perform, a reasonable deduction should similarly be made.

Treatment of Contingencies Affecting Output.

While a man is working on bonus, his output will often be reduced by hindrances, due to circumstances over which he has no control. It is unfair that he should suffer penalisation in this way, and arrangements must be made to allow bonus credits in cases where such grants are merited.

Contingencies vary in character, and consequently their treatment will not be identical. Where a stoppage is definite, the remedy is simple; it lies in "booking off" the job until production can be resumed. The more troublesome ones to handle occur when output is hindered by the intervention of contingencies which were either unforeseen or have become accentuated

since the rates were fixed. Fettling will generally suffer from this complaint to an appreciable extent owing to the difficulty of visualising the condition in which castings will turn out from the moulds; some may be very badly "burnt in," others may have an excessive amount of "fin," etc. Obviously the man must be awarded some extra time when he is set an additional task outside the scope of average conditions, on which bonus rates must normally be based.

A certain amount of difficulty may be experienced in the choice of the man to be responsible for the granting of bonus credits. Three are eligible, viz., the rate fixer, the inspector, and the foreman. The rate fixer will be too far removed from the shops to be readily available; also, the performance of such duties would interfere with his normal work. The inspector will prove the most suitable selection for the granting of credits where the additional trouble is connected with the actual work itself, and not to some defect or breakdown in general production organisation. He must essentially work in close collaboration with the rate fixer, and all credits will be certified by the latter.

As the foreman will himself receive bonus remuneration, based to a certain extent on the earnings of his men, he must not deal with rate fixing if it can possibly be avoided. Yet where it is necessary to grant bonus credits on account of any breakdown or delay in production caused through some defect of auxiliary supply of materials, power, etc., the foreman is the man most fit to decide the amounts. An efficient check can be kept on the foreman by the presentation of a weekly report, divided departmentally, to the foundry manager, showing all credits granted on these grounds. If the amount is excessive, it will either throw a reflection on the foreman's organising power or indicate serious weaknesses in production facilities.

Preliminary Trial of Production Methods.

Before work is definitely issued for production, the proposed methods should receive a try-out to ensure their practicability. This recommendation applies particularly to moulding and coremaking. Not only will a large amount of defective work be thus avoided, but the knowledge that the work can be carried out in the manner laid down will materially assist the foreman, and have considerable moral effect on the men.

The most satisfactory way of fulfilling this plan is to arrange that all production work, on which there lies any doubt as to practicability of methods, shall be tried out by an experimental department. The expression "department" must not be taken too literally. In a small foundry, it may include one man only working in the main shop; in a large foundry, it may actually constitute a small staff housed in a separate bay or shop. In either case, the principle remains the same.

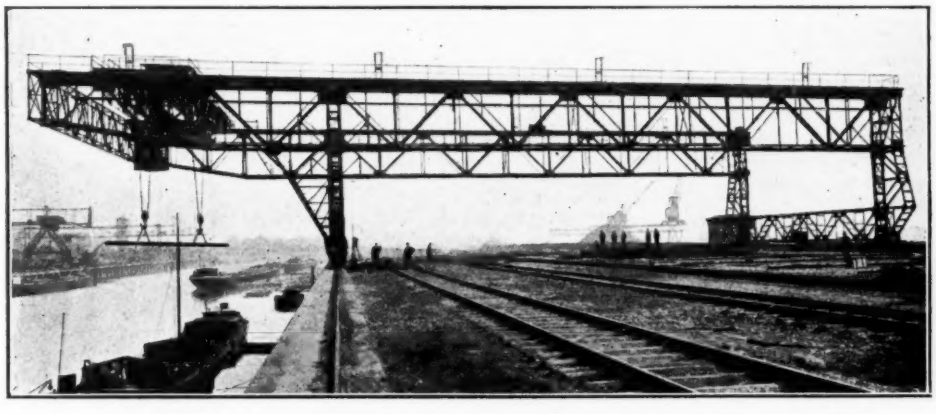
The saving, made over the practice of allowing men to try out the work they are allotted, will be considerable in the case of foundries where a considerable amount of machine and plate moulding is carried out.

Where jobbing work is paramount, the principle will be more difficult of application, for the number of castings off a pattern will rarely justify an official experimental casting. Nevertheless it should be practised wherever possible.

A New Loading Bridge for Iron and Steel Products.

A loading bridge of quite exceptional dimensions and design was erected a short while ago at the storage yard of the Rheinische Stahlwerke, at Duisburg-Meiderich, by the Demag of Duisburg. The bridge, which is shown in the annexed illustration, is used to load iron and steel products from the railway trucks or from storage into the ships; it spans three widely-spaced railway tracks and a large storage yard.

The plant consists of two travelling latticework bridges interconnected by means of cross girders. The upper girders of the bridges carry the track for a cross-travelling crane. The complete bridge has a total span of 47 metres (154 ft.) between the rail centres, and a clear height of 9 metres (29 ft. 6 in.) above the rails. The jib at the riverside has a length of 20.5 metres (66 ft. 6 in.).



NEW LOADING BRIDGE AT THE RHEINISCHE STAHLWERKE STORAGE YARD.

The travelling mechanism for the bridge is driven by a three-phase 100-b.h.p motor at a speed of 32.5 metres (106 ft.) a minute against a wind pressure of 10 kilos per sq. metre (2 lbs. per sq. ft.). The motor is mounted on the upper girder of the bridge, and drives the runner wheels of the bridge at both sides through shafts and gears. The bridge runs on sixteen wheels arranged in pairs in such a manner as to allow a certain degree of oscillation, whereby the pressure on the rails is evenly distributed.

The cross-travelling crane running on the bridge has a span of 22 metres (71 ft. 6 in.), and a wheelbase of 5.065 metres (16 ft. 6 in.), and can serve a large area without shifting the bridge. A three-phase 50-b.h.p. motor, running at 585 r.p.m., gives a speed to the crane of 97.5 metres (320 ft.) a minute. The crab travelling on the upper girder of the crane can be slewed, so that loads may be picked up in any position not parallel with the crane.

The crab has a travelling speed of 53 metres (174 ft.) a minute, produced by a 15-b.h.p. motor running at 720 r.p.m. A motor of the same size rotates the crab at 2.7 r.p.m.

The hoisting gear consists of two winches operating quite independently of each other. The two hoisting motors may be driven either singly or conjointly by means of the controllers. This combination renders it possible to lower bulky pieces slantingly into the hold. Electro-magnetic brakes are provided for all movements of the bridge and crane.

The bridge has a carrying capacity of 10 tons, and is designed for operating either a beam or swivel hook as lifting tackle. Later on, lifting magnets are to be employed.

Calculating a Cupola Charge-Coke with Reference to its Diameter.

The height of the coke charge has a great influence on the total consumption of coke. The higher the coke bed, the more has the CO_2 occasion to be reduced by the incandescent coke according to the equation $CO_2 + C \rightarrow 2CO$. Th. Kleinsorge ("Die Giesserei," No. 26, 1926, p. 561) measured the height of the coke charge of a great number of cupolas and determined the CO_2 and CO content of the gas current. He found the most suitable height to be 0.59 ft. The weight of the coke charge is then calculated according to the following formula: $Pc = \frac{\pi}{4} D^2 \; h \; R = 0.463 \; D^2 \; R$, where Pc = weight of the coke charge, cwts.; D = diameter of the shaft, ft.; h = height of the coke charge = 0.59 ft., and R = weight of the coke per cubic foot.

The weight of the coke per unit volume largely depends upon the diameter of the shaft, because towards the periphery the coke is more loosely heaped than in the middle. The results of experiments which were undertaken in this direction are recorded in Table I, together with the standard coke weights; the values are plotted in Figs. 1 and 2. With the standard coke weight there can be melted and superheated only a fixed amount of iron. Heavy and medium machinery castings can be melted with 8 to 9 per cent. of coke without any difficulty, whereas light and thin-walled castings demand 10 to 12 per cent. The weight of the iron charge is calculated according to the formula: $Pi = \frac{100}{p} Pc$ (Fig. 3), where Pi = weight of the iron charge, cwts.; Pc = weight of the coke charge, cwts., and p = charge coke in percentages of the iron charge.

Keeping the weight of the coke charge constant, the air volume which must be introduced into the cupola is always the same.

Table I.

Diameter of Shaft.	Coke charge per cub. ft.	Standard Coke Weight.
ft.	cwts.	cwts.
2.624	0.178	0.54
3.116	0.238	1.07
3.28	0.259	1.29
3.51	0.269	1.54
4.1	0.276	2.15

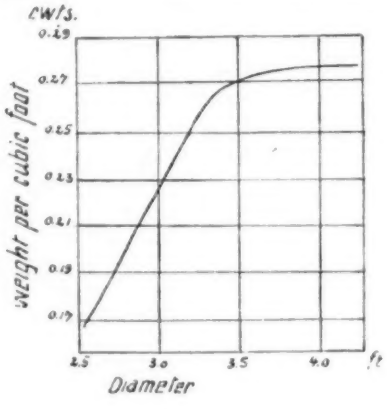


Fig. 1.

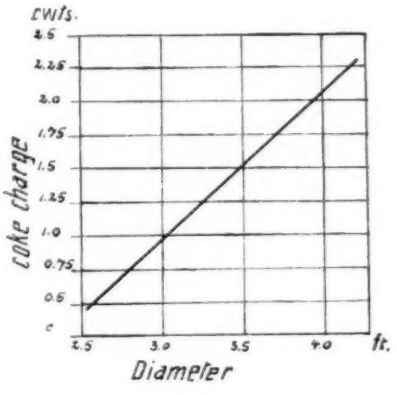


Fig. 2.

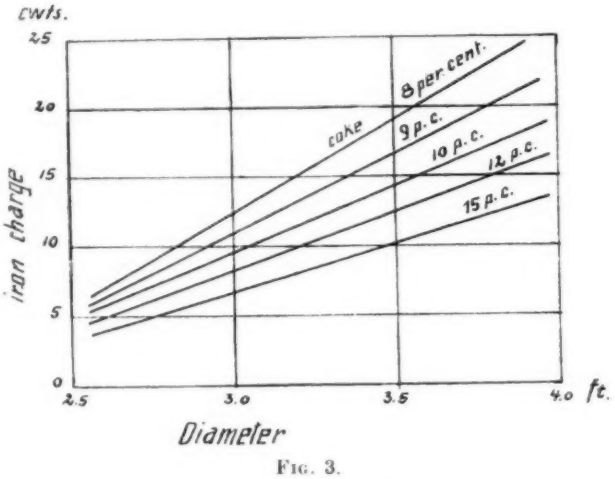


Fig. 3.

Company Reports.

Dalmellington Iron Company, Limited.—Dividend, 6d. per share, free of tax, making 5 per cent. for year.

Mansfield Engineering Company, Limited.—Loss for year, £4,167; directors propose that £21,806 be applied in returning to shareholders 5s. for every £1 share held.

Hardy Patent Pick Company, Limited.—Profit, £6,139; brought in, £11,114; dividend on ordinary shares, 7 per cent., less tax; depreciation, £2,000; carried forward, £6,602.

Nobel Industries, Limited.—Net profit, £1,018,540; brought forward, £666,597; dividend on ordinary shares for year, 10 per cent.; deferred dividend, 5 per cent.; reserve, £450,000; carried forward, £230,527.

Elliott's Metal Company, Limited.—Net profits, £70,241; brought forward, £49,586; final dividend, 5 per cent. on ordinary shares, making 10 per cent. for twelve months; depreciation, £10,000; carry forward, £54,267.

Mr. R. D. Forrester, of Minehead, Somerset, has been awarded a Fellowship of the Institution of Quarry Managers for a paper entitled "A Modern Quarry Organisation," which he submitted in competition for the Maybury Medal in July last.

The Constitution and Structure of the Commercial Aluminium-Silicon Alloys.*

By A. G. C. Gwyer, B.Sc., Ph.D., and H. W. L. Phillips, B.A., A.I.C.

Whilst certain of the properties of what are now known as "modified" aluminium-silicon alloys had been described by Minet[1] as long ago as 1891, they appear to have received no attention at the time, probably owing to the idea that silicon was harmful in aluminium. Frilley,[2] in

FIG. 1.—9.86 PER CENT. Si; 0.45 PER CENT. Fe. CHILL CAST × 200.

1911, drew attention to the fact that alloys of silicon and aluminium prepared by electrolytic reduction possessed very different properties from those prepared by solution of silicon in aluminium, and thus appears to have been the first investigator to distinguish the two types of silicon alloy now known as "normal" and "modified." The possible industrial importance of these alloys seems to have been overlooked, however, and it was not until the year 1920, when A. Pacz[3] discovered that the mechanical properties of aluminium-silicon alloys could be very materially improved by the addition to the molten metal of a small quantity of a powder consisting essentially of an alkaline fluoride, that they came into general use. In the case of alloys prepared by the solution of silicon in aluminium, Pacz stated that tensile properties of the order of 6.7-8 tons per sq. in. tensile strength with 0.5 to 1.25 per cent. elongation were usually obtained, whereas by his treatment the tensile strength could be raised to 13-14.3 tons per sq. in. with 3.5 to 11 per cent. elongation. At the same time, the fracture, from being coarse and massively crystalline, would become fine grained.

The value of these alloys was very quickly realised in America, and later in this and other countries, and investigations were made on their structure and properties. It was soon established that the improvement in mechanical properties brought about by the Pacz treatment was associated with marked changes in the microstructure and that these changes, with the corresponding improvement in properties, could be brought about by bodies other than those mentioned in the Pacz specification. Thus a patent was taken out by Edwards, Frary and Churchill,[4] covering the use of alkali metals, and mentioning that cadmium and bismuth were both capable of bringing about the desired changes. In the year 1922 an application for a patent was filed in the names of the British Aluminium Company, Ltd., and one of the present authors[5] covering the use of oxides or hydroxides of the alkali metals, and early in the following year a further application was filed in the names of the British Aluminium Company, Limited,[6] and the present authors, covering the employment of the alkaline earth metals and certain of the compounds of the alkaline metals.

Alloys as prepared by the dissolution of silicon in molten aluminium are now very generally known as "normal" alloys. They form a simple eutectiferous series with a limited degree of solid solubility at either end. According to the early investigations of Fraenkel[7] and of Roberts,[8] and confirmed later by Rosenhain, Archbutt, and Hanson,[9] the eutectic point is at 10 to 10.5 per cent. of silicon and the freezing point 576 to 578 deg C. A recent investigation by the research staff of the Aluminium Company of America[10] places the eutectic composition at 11.6 per cent. of silicon, and their diagram is in almost exact agreement with that of the present authors, who find that the eutectic composition is 11.7 per cent. of silicon and the freezing point 577 deg. C.

Alloys containing less than this percentage of silicon consist of primary aluminium together with eutectic: the silicon in the eutectic is in the form of needle-shaped crystals. The structure of a typical "normal" chill-cast specimen containing 9.86 per cent. of silicon with 0.45 per cent. of iron is shown in Fig. 1. Fig. 3 represents the structure of a slowly-cooled specimen of the all-eutectic alloy containing 11.70 per cent. of silicon with 0.36 per cent. of iron, while Fig. 4 represents exactly the same alloy as chill cast. At the centre of the micrograph will be seen a crystal of silicon, while across the upper right-hand corner of the figure is a portion of an aluminium dendrite. This structure is very typical of that of a chill-cast alloy in the neighbourhood of the eutectic composition, and it is attributed to slight supercooling of the silicon, whereby the aluminium solubility curve is crossed, followed by rapid crystallisation of the silicon from the supersaturated melt.

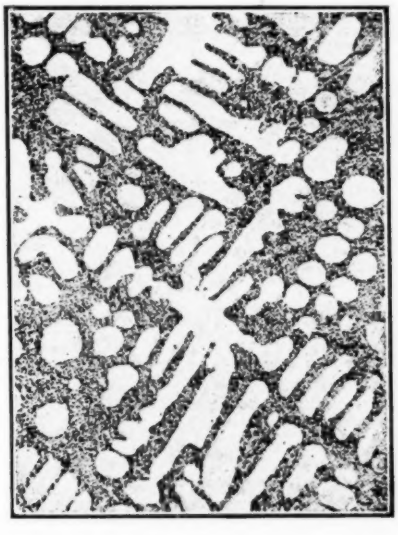


FIG. 2.—9.86 PER CENT. Si; 0.45 PER CENT. Fe. AS FIG. 1, BUT MODIFIED WITH 5 PER CENT. NaOH AT 750 DEG. C. CHILL CAST. ETCHED H.F. × 200.

Alloys containing more than 11.7 per cent. of silicon consist of primary silicon together with eutectic; the primary silicon usually appears in the microsection in the form of equiaxed crystals of regular outline, often associated with free aluminium, while the eutectic silicon possesses its characteristic acicular habit.

* A Paper read this morning before the Liege meeting of the Institute of Metals.

Aluminium-silicon alloys as prepared in the electric furnace by electrolysis, or as prepared by direct fusion of the two substances, but treated while still in the liquid state with one of the patented so-called "modifying agents," are known as "modified" alloys. They differ from the "normal" alloys in several striking particulars. The most important feature of the "modified" alloys is the marked increase in the dispersion of the silicon, and in a microsection taken from a "modified" chill-cast specimen it is no uncommon thing to find the eutectic so fine as to be resolvable only with the greatest difficulty.

Jeffries,[11] and also Edwards and Archer[12] have shown that the X-ray spectrograph of the "normal" alloy shows the pattern characteristic of free silicon superimposed upon that of aluminium, and that an identical pattern is obtained from the "modified" alloy. In other words, both silicon and aluminium are present in the same crystalline form in both "normal" and "modified" alloys, and no intermetallic compounds are formed.

The "modified" alloys form a eutectiferous series, but the eutectic composition is altered by "modification," and in the authors' experiments it was found that the all-eutectic "modified" alloy may contain as much as 15.17 per cent. of silicon. Further, the freezing point of the eutectic may be lowered by as much as 18 deg. C.

The extent of the eutectic displacement and of the lowering of the eutectic temperature is not, however, constant, but depends upon the conditions of "modification" and upon the rate of cooling employed.

Fig. 2 shows the structure of typical alloys as "modified" by the addition of 5 per cent. of sodium hydroxide at 750 deg. C., and chill-cast under the same conditions as the corresponding "normal" alloys shown in Fig. 1.

In Fig. 2 it will be seen that the primary aluminium has assumed a markedly dendritic habit, while the increase in the degree of dispersion of the silicon is striking.

Modifying Agents.

At the time when this investigation was commenced, the only "modifying agent" known to the authors was sodium fluoride, and attention was therefore directed to the problem of finding other and possibly more suitable reagents capable of bringing about the desired changes. Subsequently the issue of a patent to Edwards, Frary

FIG. 3.—11.70 PER CENT. Si; 0.36 PER CENT. Fe. SLOWLY COOLED IN FURNACE. UNETCHED × 200.

and Churchill[4] disclosed the fact that the alkali metals sodium and potassium, and to some extent cadmium and bismuth, were capable of functioning as "modifying agents," and the use of sodium for this purpose was independently discovered by Curran.[13]

During the course of this investigation the majority of the commoner elements and their compounds and some of the rarer elements were studied from this point of view.

In addition to the alkali metals sodium and potassium, and their fluorides, it was discovered

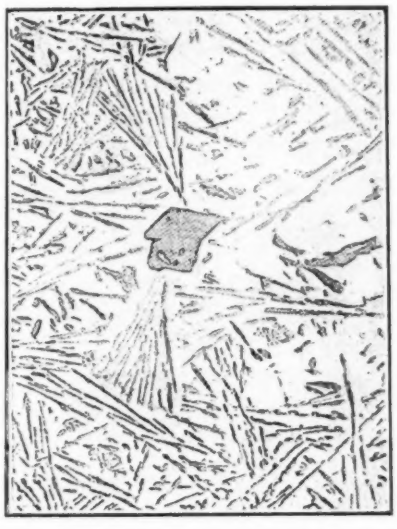


FIG. 4.—11.70 PER CENT. Si; 0.36 PER CENT. Fe. CHILL CAST. UNETCHED × 200.

that a limited number of their compounds are capable of effecting "modification"; in particular, the peroxides, hydroxides, and amides. Lithium compounds seemed to be without effect.

The metals of the alkaline earth group and their peroxides, and also magnesium, were found to be "modifiers," and cadmium was mentioned in the Edwards, Frary and Churchill patent. Zinc, although chemically resembling both magnesium and cadmium in certain respects, exercised no "modifying" effect.

Certain of the elements of the nitrogen group were found to function as "modifying agents"—namely, arsenic, antimony, and bismuth, and indeed the use of the two latter had been patented by Edwards,[14] although this was not at the time known to the authors. Phosphorus and vanadium were without action.

Theories and Modification.

One of the earliest of these theories[15] was that the "modifying agent" acted as a true flux in the chemical sense, removing alumina and silica and thus bringing about a more intimate mixing of the alloying elements. While this theory offers a possible explanation of the improvement in mechanical properties brought about by the "modifying" process, it is a little difficult to see how the very marked changes in microstructure would be caused thereby. The chief objection to this theory lies in the number and diversity of the substances capable of effecting "modification," whilst other substances, such as sodium bisulphate, which is a known solvent for alumina, and sodium carbonate, which reacts with silica, are entirely without "modifying" action.

Another theory, and one which was held by the present authors during the earliest stages of this investigation, was that there were in reality two systems of aluminium-silicon alloys, one stable, the other metastable. Subsequently it was discovered that there was not an absolutely sharp distinction between "normal" and "modified" alloys, but that it was possible to obtain a series of alloys showing a regular gradation in structure between fully "normal" and fully "modified." Conclusive evidence as to the absence of any metastable constituents—chemical compounds or allotropic modifications—in the "modified" alloys, as mentioned above, was first established by Jeffries,[16] who examined the alloys by means of the X-ray spectrometer and was successful in showing that both "normal" and "modified" alloys gave the usual diffraction pattern charac-

teristic of a mixture of aluminium and silicon. In view of these facts, and of the thermal evidence, this theory was abandoned.

A further suggestion was advanced by Curran[17] that in the case of "modification" by sodium fluoride a true ternary alloy of aluminium, silicon, and sodium is formed, and for this reason the "modified" alloys fail to conform to the usually accepted binary aluminium-silicon diagram. As such an extremely small quantity of sodium (0.1 per cent.) is required to effect "modification," it is not surprising that its presence is not shown by the X-ray spectrometer.

Sodium is the Final Modifier.

It is very probable that sodium fluoride is reduced to metallic sodium in the manner suggested, but on the other hand there are many alkali compounds which are known[18] to be reduced by molten aluminium, and among these latter are the sulphates, carbonates, and chlorides. Although experiments were carried out in the course of this investigation over a wide range of temperatures extending up to 1,700 deg. C., no "modification" was obtained with any of these classes of bodies. With sodium chloride there was no doubt but that sodium was produced, as shown by flashing of the surface, but this body not only will not "modify" a "normal" alloy, but will actually bring about rapid reversion to "normal" in the case of a previously "modified" alloy.

Even assuming, however, that this hypothesis were right, and that "modification" in this case were due to sodium entering the alloy, there is no doubt but that the ordinary laws of heterogeneous equilibrium are entirely inadequate to account for the phenomena observed. Sodium may enter the alloy as such, or may enter into combination with aluminium or silicon, or both. The present investigation has shown that with high percentages of sodium an additional constituent is present, and it might be thought that the "modified" eutectic is in reality a ternary eutectic of this constituent with aluminium and silicon. The all-eutectic alloy would consist, at the moment of solidification, of three solid phases, liquid and vapour in a three component system, and, from the theory of heterogeneous equilibrium, would therefore be invariant. But in fact the composition of the all-eutectic "modified" alloy may vary, according to the present experiments, from 11.99 per cent. of silicon to as much as 15.17 per cent., and the temperature of the eutectic separation may vary between 577 and 559 deg. C. Further, this alloy should have its freezing and melting points constant and coincident, whereas it has been found that the temperature of the eutectic separation is lower, the faster the rate of cooling, and irrespective of the temperature at which the alloy freezes, it melts at 577 to 578 deg. C.

It is known that sodium and aluminium are almost completely immiscible in the liquid state, and it is therefore possible that in commercial aluminium-silicon alloys a separation might take place into two liquid phases. Here again the laws of heterogeneous equilibrium would postulate an invariant point, the alloy consisting of two solid phases, aluminium and silicon, two liquids, and vapour, and would further require constancy and coincidence of the melting and freezing points.

The "modified" structure is essentially a metastable one, and a crucible full of metal which would give a fully "modified" ingot on chill-casting, would, if stirred, give an ingot possessing a fully "normal" structure. It is therefore evident that the true explanation of "modification" would have to be looked for in some condition of transient stability. A series of articles by Jerome Alexander[19]—to whom the authors would acknowledge their indebtedness—furnished a clue to the required solution. A brief outline of the authors' theory was included in the specification of the British Patent 219,346, and some time after the filing of this application an article appeared by Edwards and Archer[20] showing that the research staff of the Aluminium Company of America had arrived at very similar conclusions. In this publication these authors put forward two theories. According to their investigations sodium is soluble in molten aluminium to a very slight extent, and the solubility decreases rapidly with falling temperature. They assume that when the "modifying agent" is added a certain amount of sodium is dissolved corresponding with the solubility relations at the temperature; this sodium is thrown out of solution in an extremely fine state of subdivision as the alloy cools, and, according to one theory, is assumed to obstruct mechanically the crystallisation of the aluminium and, more especially, of the silicon, the molten alloy thus tending to become supersaturated with respect to the silicon. The finer structure of the eutectic in "modified" alloys is ascribed by them partly to the obstructing effect of the globules of sodium, and partly to the rapid formation of silicon nuclei in the undercooled, supersaturated liquid. According to their alternative theory the growth of the silicon crystals is hindered, not mechanically, but by the adsorption of sodium, the latter functioning as a protective colloid. In their opinion it is purely a matter of speculation which of these two theories is correct.

Theory of Modification.

The authors' theory of "modification" may be briefly stated as follows:—

When aluminium-silicon alloy is molten, and at a temperature considerably higher than its melting point, it is probable that the silicon and aluminium are in true solution; in other words, both constituents exist in a state of atomic dispersion. When solid the greater portion of silicon is present, dispersed in crystals of size readily visible under the microscope. A small quantity, of the order of 0.5 per cent. at room temperature, remains in atomic dispersion in the aluminium in "solid solution," but this may be disregarded at the moment.

In solidifying, the silicon and aluminium pass from atomic dispersion to the crystalline form, and it may be assumed, with Alexander,[19] that this transition is gradual. At some stage during the process, therefore, the silicon and aluminium aggregates will be of "colloidal dimensions," and will therefore possess some, at least, of the properties associated with the colloidal state.

It cannot be too strongly emphasised that while originally the term "colloid" was retained for such substances as albumen, gelatin, casein, etc., at the present day the term simply refers to a particular state of subdivision, and has no reference to the nature of the substance in question. Colloid chemistry is solely concerned with particles of such dimensions that surface effects, such as surface tension and electrical charges, cannot be neglected, and indeed play a greater part in determining the behaviour of the particle than other more intrinsic properties, such as chemical reactivity. Alexander gives the diameter of particles lying within the colloidal limits, and possessing colloidal properties, as 10^{-7} cm. to 10^{-5} cm., the largest being just beyond the limit of resolvability of a microscope.

The authors have been successful in preparing a silicon alloy of which the eutectic was just not resolvable with monochromatic blue light using a 4-mm. objective of N.A. 0.95, but which could just be resolved with a 2-mm. objective of N.A. 1.30. It is thus clear that even when solid, "modified" silicon alloys contain particles only just beyond the limits of colloidality, as laid down by the workers in this field. It should be particularly noted that colloidality involves no assumption as to the shape, internal structure, or orientation of the colloid particles, size alone being the critical factor.

It is well known that the colloid state is an unstable one, and that the colloid particles tend to grow or to coalesce. Their rate of growth may be accelerated or diminished by the addition of appropriate reagents, and these are known as coagulants and protectors respectively. Having regard to all the facts which have come to light, not only in their own investigations on these alloys, but also in those of others, it appears to the present authors that the most satisfactory explanation of the behaviour of "modifying agents" is to assume that they function as colloid protectors. They do not, of course, confer

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complete protection upon the colloidal silicon and aluminium, but simply retard their aggregation.

From the changes in the crystalline form of the constituents brought about by the process of "modification," it is probable that the protector itself is a colloid. It does not, however, appear to the authors that, without further evidence, the assumption is justified that when sodium compounds are used for "modifying" the protector is necessarily metallic sodium. It is extremely rare, as regards other dispersion media, for a colloid protector to be a simple substance, and for this reason one would hesitate to assume that it is free sodium which is functioning. Further, as has been mentioned, certain of the compounds of the alkali metals are known to be reduced by aluminium, yet these do not necessarily "modify" aluminium-silicon alloys. The discovery by the present authors, as mentioned previously, that with high percentages of sodium an additional constituent is present, makes it possible that in aluminium-silicon alloys sodium does not exist as such, and in any case, in the absence of further evidence, it cannot safely be assumed that even if present the solubility relationships of metallic sodium in the liquid alloy will be similar to those in pure aluminium. As is well known, immiscibility in the liquid state is generally reduced by the introduction of an alloying element, in this case silicon. The question of the precise nature of the protector must therefore be regarded as unsolved.

It would appear that the process of "modification" of aluminum-silicon alloys is somewhat analogous to the manufacture of ice-cream. The use of a colloid such as egg or gelatine leads to the formation of very fine crystals of ice, giving the required smooth texture; if the colloid is omitted the ice crystallises in the form of large sharp crystals. According to Alexander,[19] the function of the colloid is that of a protector.

The evidence on which this theory of modification is based may be best considered under the following headings:—(1) "Modification" without the use of a protector; (2) thermal analysis; (3) effect of variation in the quantity of "modifying" agent used; and (4) application of the principles of protection and coagulation to other alloy systems.

Reversion.

It is well known that the "modified" structure is a somewhat unstable one, and that it tends to revert to the "normal." This reversion may be accelerated by allowing the metal to stand for too long in the molten condition after the addition of the "modifying agent," and may also be brought about by mechanical agitation during solidification.

Further, if the metal be allowed to cool slowly through the solidification range, a general coarsening of the eutectic takes place, though in the absence of the mechanical agitation the eutectic still remains "modified" in the sense that the particles of silicon are rounded and not acicular. A coarsening of the eutectic also occurs if excess "modifying agent" be added; this is a species of reversion and causes some deterioration in the mechanical properties.

During the course of these experiments it was found that reversion could be accelerated by the addition to the melt of various alkali halides, of which easily the most efficient was sodium chloride. It was found that at 850 deg. C. the addition of 1 per cent. of sodium chloride caused reversion to take place about three times as rapidly as usual, the acceleration being much greater with larger quantities. As far as could be ascertained, the product was indistinguishable from a "normal" alloy as ordinarily prepared by the solution of silicon in aluminium. The precise action of the sodium chloride is not fully understood, but in the authors' opinion it is probably purely physical—that is to say, it acts as a coagulant to the protector, which is almost certainly a colloid, present in the original, modified, alloy.

"Colonisation."

Reference has previously been made to a coarsening of the eutectic grain boundary which frequently occurs to a slight extent in "modified" aluminium-silicon alloys. Where it occurs, even a slight coarsening of the boundary gives the eutectic the appearance of having crystallised in distinct "colonies"—the term is due to Benedicks—and therefore the exaggerated effect may conveniently be termed "pronounced colonisation."

Experiments have shown that pronounced colonisation is met with if the quantity of "modifying agent" is excessive; is more prevalent on the silicon side than on the aluminium side of the "modified" eutectic point, and generally is more common in sand than in chill-castings.

Effect of Impurities.

The impurities which may be present in aluminium-silicon alloys may be divided into three classes:—

(*a*) Non-metallic, *e.g.*, oxides, nitrides and carbides.

(*b*) Metallic, entering into solid solution in the aluminium.

(*c*) Metallic, forming additional constituents.

During this research no experiments have been carried out in connection with class (*a*). With regard to class (*b*), copper and zinc are the most common examples of metals forming solid solution with the aluminium. With copper the range extends up to some 5½ per cent. in pure aluminium, and with zinc the range extends up to about 20 per cent., but in both cases the amount capable of being taken into solid solution is probably reduced in commercial silicon alloys. Within the limits of solid solubility, both these elements accentuate colonisation. Beyond the limits of solid solubility new constituents appear. The present investigations have not been carried sufficiently far to enable the authors to state whether these are constituents of the binary system or are ternary constituents.

The majority of metallic impurities are included in class (*c*). The most important of these is iron.

In view of the importance of a knowledge of the constituents present and their physical properties, both in commercial silicon alloys and in aluminium of ordinary commercial purity, the present authors have made a detailed study of the aluminium-iron-silicon ternary system of alloys. Their object was to find out what constituents would be present in the metal as ordinarily cast, and how far the cast structure differed from the equilibrium structure.

Calcium is present as an impurity in most samples of commercial silicon, and as this metal functions as a "modifying" agent, aluminium-silicon alloys prepared by solution are frequently found to be partially modified. If more than 0.2 per cent. of calcium is present its presence can be recognised by the appearance in the microsection of characteristic needles of a pale blue colour, readily attacked by hydrofluoric acid. Below that figure the calcium would appear to be adsorbed by the silicon.

REFERENCES.

1 *Compt. rend.*, 1891, 112, 1215.
2 *Rev. Mét.*, 1911, 8, 457.
3 U.S. Patent 1387900 of Aug. 16, 1921. British Patent 158827.
4 U.S. Patent 1410461. Filed, Nov. 27, 1920. Patented, Mar. 21, 1922. British Patent 171997.
5 British Patent 210517. B. A. Co. and Gwyer. Filed, Oct. 31, 1922.
6 British Patent 219346. B. A. Co., Gwyer and Phillips. Filed, Jan. 27, 1923.
7 *Z. anorg. Chem.*, 1908, 58, 154.
8 *J. Chem. Soc.*, 1914, 105, 1383.
9 "Eleventh Report to the Alloys Research Committee of the Institution of Mechanical Engineers," 1921.
10 Edwards, *Chem. and Met. Eng.*, 1923, 28, 165.
11 *Chem. and Met. Eng.*, 1922, 26, 750.
12 *Ibid.*, 1924, 31, 504.
13 *Chem. and Met. Eng.*, 1922, 27, 360.
14 U.S. Patent 195048. Filed, Feb. 14, 1923.
15 *Cf.* Guillet, "Les Alliages Al-Si et leurs emplois industriels," *Rev. Mét.*, 1922, 19, 303, a translation of which, by R. J. Anderson, was given before the American Foundrymen's Association, Oct. 1924.
16 Jeffries, *Chem. and Met. Eng.*, 1922, 26, 750.
17 *Ibid.*, 1922, 27, 360.
18 Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry," vol. v. p. 219.
19 *Chem. and Met. Eng.*, 1922, 26, 54, 119, 170, and 201.
20 *Ibid.*, 1924, 31, 504.
21 U.S. Patent, filed Jan. 27, 1920. British Patent 171997.

German Foundry Owners' Association.

This year's general meeting of the Verein Deutsche Eisengiessereien (German Foundry Owners' Association), was held on August 25 to 27 at the Institute of the German Engineers, Berlin, under the chairmanship of Dr. Werner, the Association's President. Representatives from associated works in every part of the country attended for the purpose of common discussion and deliberation directed to the devising of measures for overcoming the difficulties of the present economic situation. The first two days were therefore devoted to the sittings of the committees and other special sections of the Association. A number of technical papers on research and other work of special importance to foundries at the present time were also presented. These were abstracted in our issue of September 2.

A reception was held on the evening of August 26 at the Deutsche Gesellschaft, when the members, with numerous representatives of the Reich and provincial official bodies, and representative members of the parliamentary, scientific, industrial, commercial and journalistic circles, had an opportunity for social intercourse and the informal discussion of subjects of common interests.

Presidential Address.

The general meeting proper was held on August 27, a large number of guests of honour being present. In his address of welcome the President expressed pleasure that notwithstanding the economic difficulties of the time, the meeting was so well attended. He then gave a report on the past business year that had been marked by the most severe economic crisis, which influenced the membership roll. Whilst gaps had been made in the membership through deaths, a number of works, including many that were long-established, had collapsed through economic pressure, and although individual new members have joined, these were not sufficient to compensate for the losses. The membership now numbered 1,339.

The Association's activities covered the procuring of the best possible supply of raw materials, and the regulation of prices and conditions of supply for foundries by keeping in constant touch with the supplying and consuming associations, by developing the works and price associations, and extending the organisation of the Scrap-Purchasing Company of the Association. The greatest attention had been devoted to the improvement of costing, as well as to the equipment and improvement of works on the most systematic and scientific lines, in which connection the Foundry Advisory Company, established by the Association last year, had rendered valuable and growing service.

By supporting technical colleges and institutes, as well as by helping needy students of foundry work, the Association has endeavoured to advance the industry and to promote the specially important work of ensuring that the rising generation shall be competent. The Association's more general economic work—in regard to questions of taxation, transport and commercial matters with a political bearing—was carried out in close co-operation with the leading employers' federations and other allied bodies. The Berlin business office of the Association played a specially active part in these departments of work, particularly in negotiations with the Government authorities.

The technical work of the Association included the organisation of the Düsseldorf Foundry Exhibition, which was decided upon at the previous year's general meeting and excited most favourable opinions both in Germany and abroad. A film of the most important exhibits was produced, thereby bringing them within the reach of those who were unable to be present. Among the subjects of a technical nature to which attention has long been devoted may be mentioned that of the design of castings, the researches on which had now resulted in definite conclusions, and also the drying of moulds and the utilisation of waste material. Among the new subjects of study taken up were investigations in connection with recent cleaning devices for castings, the causes of different properties in pig-iron and cast iron of precisely the same composition, and the behaviour of cast iron under high temperatures. The standardisation work was also considerably advanced.

A New Dictionary.

A new, enlarged and improved edition of the Association's "Foundry Handbook" ("Giesserei-Handbuch") was completed. A German-English "Foundry Dictionary" was also issued, which supplied an aid hitherto lacking to the German foundryman visiting England or America, or the English or American foundryman visiting Germany. The desire for a knowledge of English among members of the industry was also met by the institution of lectures on technical English. A recognition of the importance of discussing technical problems of the industry directly with technical associations in other countries resulted in a large number of German foundrymen attending the London and Detroit exhibitions.

"Die Giesserei," the organ of the Association, again published a large special number on the occasion of the general meeting. It contained articles on the investigations relating to drying apparatus, together with the prize papers received in connection with the prize competition recently instituted by the Association.

After the adoption of the President's business report, the general meeting passed a resolution conferring the Siegfried-Werner Medal on Professor Rudeloff, Berlin, in recognition of his great services in the technical sphere of foundry work.

After the transaction of the usual business, Dr. Geilenkirchen, of Düsseldorf, the business director of the Association, delivered a report on "The Economic Year 1925-26."

Economic Year 1925-26.

Dr. Geilenkirchen alluded at the outset to the statement in the last report of the Agent-General for Reparation Payments, covering nine months, to the effect that Germany had now reached the stage of economic reconstruction. He showed, on the other hand, that it is impossible to say more than that the country has reached the stage of clearing up the ruins which post-war policies had left behind, a process which is now being carried out by means of systematic amalgamations in every field of industry, those works which show insufficient vitality being eliminated. In the endeavour to restore prosperity to Germany's economic life on a new basis, the Government, however, did not have a clear economic programme. This defect was remedied only last winter by the publication of a report of the Reich Association of German Industrialists on "German Economic and Financial Policy," which constituted an economic programme. This economic programme demands, on the one hand, the observance of the utmost economy in public expenditure, a reduction in the considerably over-staffed public administrations, and a definite policy in respect to railway and postal tariffs, which should have regard to the capacity of industry to bear them.

In regard to social charges, the report, while fully recognising the necessity of maintaining social relief and employment, emphasises the principle that such expenditure must primarily be governed by the productivity of industry, and that, before anything else, the greatly excessive cost of administering the social insurance scheme must be reduced. In regard to the output and payment of the workers, it is urged that these should be in harmony with each other, and that the compulsory establishment of higher wages than the actual output justifies should be discontinued. The hours of work also should not be regulated in a cut-and-dried fashion, but should be adapted to the needs of particular industries.

Credit Rationing.

In the sphere of banking and credit, the report recognises that the rationing of credit by the Reichsbank was necessary and reasonable; but the system of credit rationing ought to be more elastic than was the case in Germany. The high cost of credits ought to be lowered by reducing the Reichsbank discount rate, and, in addition, the

banks themselves should be required to lower their high expenditure by systematising their organisations, and give industries the benefit of the saving effected. Germany's commercial policy must first of all aim at promoting as far as possible the export of home manufactures; her negotiators must, therefore, have a suitable Customs tariff at their command, which, however, should not be an end in itself, but merely a means of advancing commercial relations.

In the second part of its economic programme the Reich Association refers to industry itself, and urges the most drastic co-ordination and concentration of works, the development of the cartels with the elimination of all excrescences, and the promotion of legitimate trading as an instrument for the distribution of commodities.

This economic programme of the Reich Association was criticised by the speaker on the ground that it does not say a word about the Dawes Plan, which, however, places a burden on German industry considerably heavier than any other factor. The report, moreover, does not emphasise the necessity of abolishing the last remnants of control, particularly in connection with housing, nor does it give due consideration to the importance of agriculture, by the promotion of which the large import of foodstuffs and fodder can be considerably reduced on the one hand, while, on the other, the agricultural machinery would be given permanent employment.

Steps Taken.

In the light of this industrial programme, Dr. Geilenkirchen examined the economic incidents having a political bearing during the business year. The German Government has confined itself to the formation of a Commission of Economic Inquiry for the study of different fields of economic life; but it may be assumed that by the time this Commission is in a position to submit ameliorative proposals, the economic crisis will have already been changed for better or worse. The reduction of taxation which took place in April means a considerable relief to industry, although it was not effected by reduction on the expenditure, and merely by having recourse to other sources of income.

The need for saving by cutting down the machinery of administration was at the same time emphasised by the Minister of Finance, but so far this has not been translated into practice. According to the statements of the Minister of Finance, the position in regard to taxation during the past few months has been gratifying; it is to be hoped, however, that this financial optimism will not be falsified by facts. The recently published balance sheet of the Reich Railway Company, notwithstanding the unfavourable economic position generally, is also very satisfactory, and, at any rate, justifies the demand for a reduction in freights. In any case, the Reich Railway, like every other industrial undertaking, must be protected in future against further excessive expenditure on account of increased wages and social benefit schemes. On the whole, the compulsory increase of wages as a result of binding arbitration awards has certainly abated in the course of last year; on the other hand, the burden caused by social legislation has been continually increasing. Particular reference was here made to the recently enacted Reich Workman's Law, in which a departure was made from equality of participation in the administration as between employers and employed in favour of the latter.

Labour Conditions.

In the matter of the regulation of working hours no restrictions have been put into force during the year. The trade union authorities and those in the Ministry of Labour of the Reich are, however, looking with longing eyes to the ratification of the Washington Agreement, although this has so far been rejected in every other State.

In the sphere of credit the desired reduction of the Reichsbank's discount rate from 9 to 6 per cent. has taken place, and thereby the credit conditions in Germany have gradually been brought back to a normal condition. During the year several commercial treaties and provisional agreements have been concluded, but on the whole these cannot be characterised as particularly satisfactory. They have served to show that the German Customs tariff is by no means yet a really suitable basis for the negotiation of commercial agreements. The far-reaching conflict of interests between the different branches of industry in connection with the conclusion of commercial treaties has also led to undesirable recriminations. Many negotiations in this department could not be carried to a successful issue in several countries in Europe owing to currency depreciation. For the same reason the World Economic Conference desired by many countries would at the present juncture have no significance. The iron-producing industry of Germany has come to an understanding with that of the Western Continental countries, and it would appear that the outcome will be the gradual formation of a European iron syndicate, which, even if it should entail an increase in price of iron products, will nevertheless secure equality of conditions as regards world competition for all countries.

Dawes Plan.

Should the World Economic Conference be realised, one of its principal tasks will be to investigate the effects of the Dawes Plan upon world economics. In countries outside Germany it is being increasingly recognised that the Dawes Plan is not merely an intolerable burden on German industry, but that the payments which it prescribes disorganise the economic system of the countries receiving the payments, for which reason the Dawes Plan must either be modified or entirely done away with.

Meanwhile the effect of the Dawes Plan—an effect foreseen by serious economists—is to be seen in unemployment, which in Germany is increasing to a gigantic figure The Government, after looking on inactively for months while these conditions were developing, at length came forward at the end of last June with a scheme for the reduction of unemployment, principally by the provision of relief work. The problem of diminishing unemployment can be reduced to a simple formula; on the one hand, the workers who during the war were taken away by every possible means from agriculture and put into war industries must be got back, as far as practicable, to the land; while, on the other hand, industry, by the realisation of the economic demands which have been described, must be placed in a position to work profitably and thus provide profitable employment in return. On behalf of the unemployed still remaining when these measures are carried out, owing to the restriction in the basis of production of German industry, supplementary labour schemes such as the Government contemplate would have to be provided. The problem of unemployment has become a question of life or death to Germany. Even if it should be impossible to reduce considerably the number of the workless before the winter, it is at least to be hoped that it will be possible to prevent its further increase. To solve this problem completely in the sense of promoting universal well-being, the responsible and cheerful co-operation of all classes of the people is necessary, and particularly of the workers themselves. Fortunately, signs are not wanting that such a spirit is growing, even among the working classes, and that as a result the economic life of Germany will once again assume its normal trend.

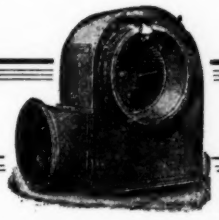
Legal.

Non-payment of Insurance Contributions.

At Camborne police court, on Tuesday, Mrs. C. A. Pratt, of the firm of Terrill and Rogers, iron founders and cooking-range manufacturers, of West End, Redruth, was summoned for failure to pay National Health and Unemployment Insurance contributions in respect of eight employees.

Mr. F. H. Comfort, of Plymouth, prosecuting on behalf of the Ministry, stated that the sum involved was about £35, £20 of which had been deducted from the wages of the workmen in question. He added that difficulty had always been experienced in getting defendant to stamp the cards.

Defendant, who pleaded guilty, was fined 10s. on each of 24 summonses, and ordered to pay the arrears and £1 costs, a sum of £48 in all.



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Trade Talk.

THE FURNACE at the Bynea Steelworks, Llanelly, was started on September 6 and work for 200 men will be found.

SIR WILLIAM ARROL & COMPANY, LIMITED, are to supply a 50-ton floating crane for use at Lagos harbour, West Africa.

SIR JAMES LAING & SONS, LIMITED, Sunderland, have an order for an oil-tanker of 8,000 tons for the Burmah Oil Company.

HENRY BERRY & COMPANY, LIMITED, Leeds, are supplying twenty sets of hydraulic pumps for Synthetic Ammonia and Nitrates, Limited, Billingham, Stockton-on-Tees.

SWAN, HUNTER, & WIGHAM RICHARDSON, LIMITED, Neptune Yard, Walker, have secured a contract for a self-loading vessel of about 2,000 tons deadweight, for service on the Canadian lakes.

THE ROSYTH SHIPBREAKING COMPANY, LIMITED, have acquired from the Admiralty the 40,000-ton German floating dock, which is 656 feet long and 187 feet wide. The dock is to be broken up.

THE COMPANIA ESPANOLA DE MINES DEL RIF reports for 1925 shipments amounting to 279,912 tons of iron ore, with an average content of 63.541 per cent. of iron and 4.568 per cent. of silicon.

AS BRIEFLY reported last week, in the face of the keenest competition from the United States of America, Braithwaite & Company, Limited, have secured a contract to supply 24,000 tons of pipes for the water supply undertaking of the city of Sao Paulo, Brazil. The value of the contract is a little over £500,000. A special feature of the contract is that the pipes are to be made of "Armco" iron. The billets, to be purchased in America, will be re-rolled by Guest, Keen, and Nettlefolds, Limited, at their Dowlais works, and the material will be fabricated at Messrs. Braithwaite's works at Newport. Messrs. Braithwaite are erecting a works in Brazil to complete the pipe-line.

Obituary.

MR. E. E. S. VELLINGHAUSEN, iron and steel merchant, of Armadale, Holland Avenue, Sutton, Surrey, has died as the result of an accident at Victoria Station of the Southern Railway. He was 60 years of age.

MR. W. H. ALLEN, J.P., ex-High Sheriff of the County, died at Bromham House, Bedford, on September 3. The deceased was born at Cardiff in 1844, but left Cardiff some sixty years ago, and built up at Bedford a great business firm, W. H. Allen & Company, Limited, an engineering firm with world-wide ramifications. Intended for the engineering profession, he served an apprenticeship with the old-established Llanelly firm, Richard Nevill & Company, and after a sound, practical training, became interested as far back as 1859 in a small works, the Mill Lane Foundry, Cardiff, then employing about 120 men. Two years later Mr. Allen went to London, where for several years he was manager of a large engineering works. In 1880, however, in York Street, Lambeth, he founded the business of W. H. Allen, Sons & Company, Limited. Mr. Allen went to Bedford in the 'nineties, and founded the Queen's Engineering Works, which have since carried out large contracts for Egyptian irrigation works and Japanese dockyards. He was a member of the Grand Council of the Federation of British Industries, and vice-president of the Institution of Mechanical Engineers. In the early days of his business Mr. Allen took his son, Mr. Richard Allen, then only 22 years of age, into partnership, and since then he has taken in his other sons, Mr. Harold Allen and Mr. Rupert Allen, as well as his son-in-law, Colonel Percy B. Crowe, all of whom are directors. Mr. Richard Allen is now managing director; Mr. Harold Allen, joint managing director; and Mr. Rupert Allen is in charge of the electrical part of the business.

A DISPUTE involving the alleged victimisation of five trade unionists has been settled by the return to the National Radiator Works, Hull, of men who had been compulsorily unemployed for 12 weeks. At a mass meeting, members of the Municipal and General Workers' Union, the Amalgamated Engineers' Union, and the Stove, Grate and Metal Workers' Union elected a joint committee to conduct future negotiations respecting the wages and conditions of National Radiator workers.

New Companies.

Base Metal Extraction Company, Limited, Imrie House, 33-36, King William Street, E.C.4.—Capital £825 in 1s. shares.

Lintos Gear Company, Limited, Sentinel House, Southampton Row, W.C.1.—Capital £250 in 1s. shares. Engineers, iron and brass founders, etc. Directors: S. J. Tome, E. M. Ling and G. A. Parker (permanent managing director).

Taylor Tunnicliff (Refractories), Limited.—Capital £10,000, to acquire the Albion Works, High Street, Longton, Stoke-on-Trent, etc. Directors: W. J. Kent, A. E. Wilbraham, P. Cooper and L. H. Jones.

Contracts Open.

Ollerton, September 23.—Supply and delivery of 120 tons of 8-in., 6-in., 5-in., 4-in. and 3-in. cast-iron pipes, etc., for the Southwell Rural District Council. Messrs. Sands and Walker, Milton Chambers, Nottingham. (Fee £3 3s., returnable.)

Rothwell, Yorks, October 4.—(1) Supply of lined, etc., cast-iron or spun pipes and specials for water mains, from 3 in. to 12 in. in dia.; and (2) laying of water mains, for the Urban District Council. Mr. J. Southwart, surveyor, Rothwell, Yorks. (Fee £1 1s., returnable.)

Stafford, September 18.—(11) Castings for six months from October 1, for the Corporation. Mr. W. Plant, borough engineer, Borough Hall, Stafford.

Patent Specifications.

The following list of patent specifications accepted have been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full specification can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

30,970. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Electric furnaces. December 27, 1924. 245,089.

10,066. BURCH, C. R., DAVIS, N. R., AND METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED. High-frequency induction furnaces. April 17, 1925. 255,157.

17,937. TUTT, A. H. Apparatus relating to the drying of foundry moulds. July 14, 1925. 255,231.

26,238. BRITISH PERLIT IRON COMPANY, LIMITED. Manufacture of cast-iron articles, parts of which have very different thicknesses. November 20, 1924. 243,324.

11,095. SMALLWOOD, A., and FALLON, J. Furnaces. April 29, 1925. 255,938.

27,962. BOSSHARDT, E. Manufacture of steel. July 4, 1925. 254,673.

623. WILL, DR. E. Permanent moulds for metal casting. January 8, 1925. 245,788.

8,620. BETHUNE, G. DE. Rotary furnaces adapted to contain molten material. March 30, 1925. (Dividend Application on 8495/25.) 256,158.

11,334. NAYLOR, G. W., NAYLOR, J. F., and NAYLOR, W. Ingot moulds for casting metals. May 1, 1925. 256,306.

11,942. REDFERN, C. G. (Hartstoff-Metall Akt.-Ges. Hametag). Processes and apparatus for granulating metals. May 7, 1925. (Convention date not granted.) 233,720.

21,474. BARON, H. (Will, Dr. E.) Heat treatment of metal castings. August 27, 1925. (Convention date not granted.) 239,218.

13,051. INTERNATIONAL NICKEL CO. Manufacture of alloys. June 16, 1925. 253,879.

9,262. MARKS, E. C. R. (LIPTAK FIRE BRICK ARCH COMPANY). Furnace wall. April 7, 1925. 256,661.

4,274. ROGERS, F. H. (ECKERT PRACISIONSGUSZ-FABRIK, GEB.). Automatic machine for casting metals under pressure. February 16, 1925. 256,655.

13,198. HUNTSMAN, H. F. Boxes or cores for use in building crucible holes for crucible furnaces. May 20, 1925. 256,722.

14,937. HOPE, J. A. Furnaces. June 9, 1925. 256,738.

2,755. ENKE, F. E. J. Rotary furnace. January 30, 1926. 256,861.

4,953. WILL, DR. E. Permanent casting moulds, preferably made of metal. (February 21, 1925). 247,993.

AT FALKIRK DEAN OF GUILD COURT, R. & A. Main, Limited, Gothic Ironworks, Camelon, Falkirk, have been granted permission to erect a new enamelling shop at their foundry at an estimated expenditure of £2,025.

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—In the unsettled conditions at present prevailing, it is not surprising to find a lack of interest generally in the iron markets, and on Tees-side especially there is little inducement to either consumers or producers to speculate on the future trend of events during this period of industrial upheaval. With furnace production practically in abeyance for the time being, and stocks of pig entirely exhausted, consumers are now completely dependent upon imported iron, which, as illustrated in the following figures, amounted on Tees-side up to August 31 to 45,950 tons, as compared with 15,198 tons in the corresponding period of 1924-5 and 312 tons in 1913-4. It is, however, expected that there will be some blast furnaces in operation before this time next month, and the tendency is to hold off wherever possible and await developments. Prices now stand as follow:—No. 1, 94s. 6d.; No. 3 G.M.B., 92s.; No. 4 foundry, 91s.; and No. 4 forge, 90s. 6d. per ton.

The position in the hematite market is also becoming rather more difficult, there now being practically no mixed numbers obtainable on Tees-side, and there is only one furnace working on the whole of the North-East Coast. Sellers are calling mixed numbers 83s. per ton, and No. 1 quality 83s. 6d. per ton.

LANCASHIRE.—In this locality business in the local iron market is also uneventful, prompt supplies of pig still being at a very low ebb, and offers of late have been of limited extent. Scottish No. 3 has been selling in small quantities at firm prices, offers being on the basis of 107s. 6d. per ton, delivered Manchester or equal, with Middlesbrough brands quoted at about 105s. per ton, although a parcel said to be equal to No. 3 was disposed of recently at 103s. 6d.

THE MIDLANDS.—Consumers of foundry pig in this area are now mostly confined to Continental iron for supplies, and business is on a very restricted scale. Middlesbrough No. 3 quality foundry is still on offer at £5 6s. to £5 7s. 6d. delivered stations in this area, with 2s. 6d. per ton extra for No. 1. Small supplies of Scotch iron are on the market at about £5 12s. 6d. per ton delivered this district. Derbyshire furnaces are prepared to sell iron for delivery after the strike at about 90s. delivered here, or 80s. at the furnaces, but consumers are in no hurry to cover.

SCOTLAND.—Business in the Scotch pig-iron market is quieter, but prices are unchanged on the basis of 90s. for No. 3 at the furnaces. Middlesbrough iron is of little interest owing to the prohibitive price being asked. Continental foundry iron is, however, in fair demand, but here the price is stiffening. No. 3 foundry is offered at 77s. 6d. at Grangemouth.

Scrap.

The demand for all descriptions of foundry cupola material is again in limited volume, and in Scotland heavy turnings and cast-iron borings are entirely off the market, unless for some very small odd lots, which are being bought for stock around 35s. and 30s. per ton respectively, delivered consumers' works. Machinery cast-iron scrap still maintains its price, and some fairly good lots have been sold recently at 77s. 6d. per ton, and 70s. to 72s. 6d. per ton for heavy ordinary cast-iron scrap to the same specification, i.e., pieces not exceeding 1 cwt. Old cast-iron railway chairs are also in better demand, and some of these have been disposed of at as high as 76s. 6d. per ton, with light cast-iron scrap and firebars around 65s. per ton, all delivered f.o.t. consumers' works.

Metals.

Copper.—Influenced by the more favourable statistical position of the metal as indicated by a substantial reduction in stocks during August, the market has evidenced consistent steadiness, while only fractional quotations were marked in the transactions of the past week. It is reported over here that United States consumption is very satisfactory, while larger quantities have been despatched to Belgium, Germany and Holland. The outlook is brighter than for a long time past, and large contracts were placed recently for America and the Continent, chiefly Italy and Germany.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £59 to £59 2s. 6d.; Friday, £58 17s. 6d. to £59; Monday, £58 17s. 6d. to £59; Tuesday, £58 17s. 6d. to £59; Wednesday, £58 15s. to £58 17s. 6d.

Three Months: Thursday, £59 12s. 6d. to £59 15s.; Friday, £59 12s. 6d. to £59 15s.; Monday, £59 12s. 6d. to £59 15s.; Tuesday, £59 12s. 6d. to £59 15s.; Wednesday, £59 10s. to £59 12s. 6d.

Tin.—An outstanding event in the base metal markets of the past week was the advancing strength of tin, which, on Friday last, made an unexpected jump of £2 15s. to £305 7s. 6d. per ton, another high record since the inflated price in 1920. This is the second time this year that tin has crossed the £300 mark, the price touching £300 10s. on March 17 last. At one time, on September 7, the metal was quoted as high as £301. This development may be ascribed in part to the recent growth of disturbances in China, which is beginning to have a very adverse effect on the supplies from there, and naturally strengthens the hands of the "bulls."

Official closing prices of standard tin have been as under:—

Cash: Thursday, £302 10s. to £302 15s.; Friday, £305 5s. to £305 10s.; Monday, £309 10s. to £310; Tuesday, £307 15s. to £308; Wednesday, £310 10s. to £310 15s.

Three Months: Thursday, £295 5s. to £295 10s.; Friday, £296 10s. to £296 15s.; Monday, £298 10s. to £298 15s.; Tuesday, £297 15s. to £298; Wednesday, £299 10s. to £299 15s.

Spelter.—There is every probability of a substantial increase in the demand for ordinary spelter when the expected improvement in the manufacturing industries materialises after the settlement of the mining dispute. The world's consumption of this metal has increased more rapidly than production, and stocks are now at a low level.

The following are the week's prices:—

Ordinary: Thursday, £34 1s. 3d.; Friday, £34 3s. 9d.; Monday, £34 3s. 9d.; Tuesday, £34 3s. 9d.; Wednesday, £34 5s.

Lead.—With a much increased output of soft foreign pig and native material during the current year in prospect, with diminished consumption, it is not surprising that the metal has shown greater weakness during the past month or so. Ready offering of lead on the Continent has also had a depressing effect on the market, and under the influence of selling pressure the market has been weaker. Notwithstanding these difficulties, the market remains fairly steady, with some signs of a recovery in values.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £32 7s. 6d.; Friday, £32 1s. 3d.; Monday, £32; Tuesday, £32; Wednesday, £32 1s. 3d.

Ground Ganister,
Steel Moulders' Composition,
Silica Bricks, Refractory Goods.

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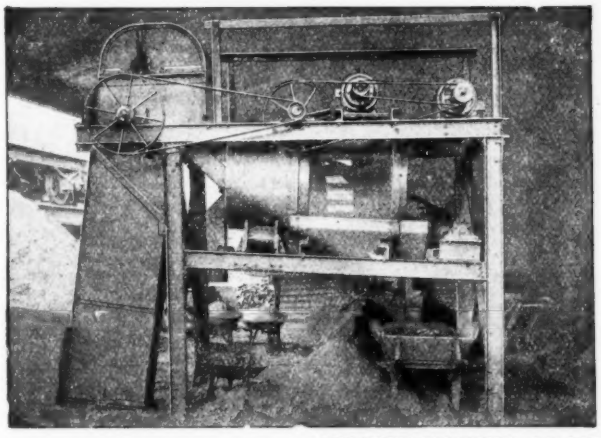

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You will be glad to hear that your Gaiters proved their worth last week when some molten steel was splashed over the legs of a man who was wearing them. Had he been unprotected he must have been badly burned, but your Gaiters stopped the metal and he escaped uninjured. We have pleasure in sending you an order for a further dozen pairs.

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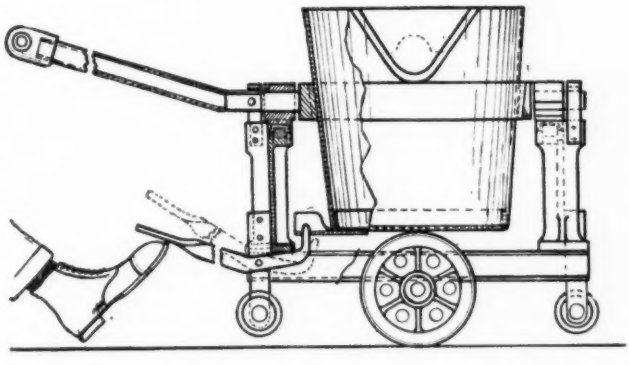

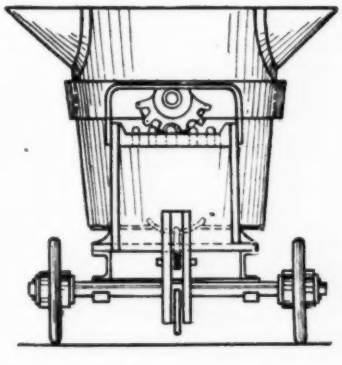

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Standard cash ..	58	15	0
Three months ..	59	10	0
Electrolytic	66	15	0
Tough	64	10	0
Best selected ..	65	0	0
Sheets	90	0	0
India	73	0	0
Wire bars	67	0	0
Do. September ..	66	15	0
Do. October ..	66	15	0
Ingot bars	66	15	0
H.C. wire rods ..	70	0	0
Off. av. cash, Aug.	58	18	4½
Do., 3 mths. Aug.	59	13	7½
Do., Sttlmnt, Aug.	58	17	7½
Do., Electro, Aug.	67	1	10½
Do., B.S., Aug. ..	66	0	10
Aver. spot price copper, Aug. ..	58	17	7½
Do., wire bars, Aug.	67	6	8
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			9½d.

BRASS.

Solid drawn tubes ..	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	310	10	0
Three months ..	299	10	0
English	309	0	0
Bars	308	15	0
Straits	307	5	0
Australian		—	
Eastern	307	0	0
Banca		—	
Off. avr. cash, Aug.	293	16	1½
Do., 3 mths., Aug.	282	2	3½
Do., Sttlmt. Aug.	293	14	6½
Aver. spot., Aug.	293	14	6½

SPELTER.

Ordinary	34	5	0
Remelted	33	0	0
Hard	28	15	0
Electro 99.9 ..	37	5	0
English	35	0	0
India	31	0	0
Zinc dust	43	0	0
Zinc ashes	16	0	0
Off. aver., Aug. ..	34	6	11½
Aver., spot, Aug.	34	3	5½

LEAD.

Soft foreign ppt.	32	1	3
English	33	5	0
Off. average, Aug.	32	11	0½
Average spot, Aug.	32	15	1½

ZINC SHEETS, &c.

Zinc sheets, English	42	15	0
Do. V.M. ex whf.	39	15	0
Rods	45	0	0
Boiler plates ..	39	0	0
Battery plates ..	38	10	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese	64	0	0
Crude	45	0	0

QUICKSILVER.

Quicksilver ..	15	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 5 0
45/50%	10 0 0
75%	17 0 0
Ferro-vanadium—	
35/40% ..	14/9 lb. va.
Ferro-molybdenum—	
70/75% c. free ..	5/3 lb.
Ferro-titanium—	
23/25 % carbonless	11d.
Ferro-phosphorus,	20/25%, £17 0 0
Ferro-tungsten—	
80/85%, c.fr. ..	1/4 to 1/5 lb.
Tungsten metal powder—	
98/99%	1/10 to 1/11 lb.
Ferro-chrome—	
2/4% car. ..	£33 0 0
4/6% car. ..	£22 0 0
6/8% car. ..	£21 12 6
8/10% car. ..	£20 15 0
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£43 10 0
Max. 0.70% car.	£54 10 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£118
Metallic Chromium—	
96/98% ...	3/- lb.
Ferro-manganese (net)—	
76/80%, loose	£14 0 0
76/80%, packed	£15 0 0
76/80%, export	£14 0 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0
Per lb. net, d/d buyers' works.	
Extras—	
Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼in. to ⅛ in.	1/- lb.
Flats, ½in. × ¼in. to under 1 in. × ⅛ in.	3d. lb.
Do. under ½in. × ¼in.	1/- lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.
Per lb. net, d/d steel makers' works.	

SCRAP.

South Wales—£ s. d.	£ s. d.
Hvy. steel ..	2 10 0
Bundled steel & shrngs. 2 2 6 to	2 5 0
Mixed iron & steel	2 2 6
Heavy cast iron	3 0 0
Good machinery for foundries ..	3 5 0
Cleveland—	
Heavy steel ..	3 0 0
Steel turnings ..	2 7 6
Cast iron borings	2 5 0
Heavy forge ..	4 2 6
Bushelled scrap	3 10 0
Cast-iron scrap	3 9 0 to 3 12 6
Lancashire—	
Cast-iron scrap	3 2 6 to 3 10 0
Hvy. wrought ..	3 2 6
Steel turnings ..	2 2 0
London — Merchants' buying prices delivered yard.	
Copper (clean)..	49 0 0
Brass (clean) ..	39 0 0
Lead (less usual draft)	28 0 0
Tea lead ..	24 0 0
Zinc	23 0 0
New aluminium cuttings ..	80 0 0
Braziery copper	45 0 0
Gunmetal ..	46 0 0
Hollow pewter	190 0 0
Shaped black pewter ..	138 0 0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1 ..	94/6
Foundry No. 3 ..	92/-
Foundry No. 4 ..	91/-
Forge No. 4	90/6
Hematite No. 1 ..	83/6
Hematite M/Nos. ..	83/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	88/6
„ d/d Birm.	106/-
Midlands—	
Staffs common* ..	—
„ No. 4 forge ..	—
„ No. 3 foundry	—
Shrops. basic	—
„ Cold blast, ord.*	—
„ „ roll iron* ..	—
* d/d Birmingham.	
Northants forge	—
„ fdry No. 3 ..	—
Derbyshire forge ..	—
„ fdry. No. 3 ..	—
„ basic	—
Scotland—	
Foundry No. 1 ..	—
„ No. 3 ..	90/-
Hem. M/Nos.	82/6
Sheffield (d/d district)—	
Derby forge	—
„ fdry. No. 3 ..	—
Lincs. forge	—
„ fdry. No. 3 ..	—
E.C. hematite	96/-
W.C. hematite ..	92/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3.. ..	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
„ fdry. No. 3 ..	—
Northants foundry No. 3	—
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	107/6
Glengarnock, No. 3 ..	107/6
Gartsherrie, No. 3 ..	107/6
Monkland No 3	107/6
Coltness, No. 3	107/6
Shotts, No. 3	107/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom. ..	11 10 0 to 13	0 0
Angles	12	0 0
Tees to 3 united ins.	12	10 0
Nut and bolt iron		—
Hoops	14	10 0
Marked bars (Staffs.) f.o.t. ..		—
Gas strip	12	10 0
Bolts and nuts .. ¾ in. × 4 in. ..	15	5 0
Steel—		
Ship plates	8	2 6
Boiler plts. ..	11	5 0
Chequer plts. ..	9	10 0
Angles ..	7 7 6 to 7	10 0
Tees ..	8 7 6 to 8	10 0
Joists ..	7 7 6 to 7	10 0
Rounds and Squares 3 in. to 5½ ins. ..	9	0 0
Rounds under 3 in. to ¾ in.	8	12 6
Flats, over 5 in. wide and up ..	9	10 0
Flats, 5in. to 1½in.	8	10 0
Rails, heavy ..	8	10 0
Fishplates	12	10 0
Hoops (Staffs.) ..	10	10 0
Black sheets, 24g.	11	5 0
Galv. cor. sheets, 24g.	16	15 0
Galv. fencing wire 8g. plain	12	10 0
Billets, soft ..		—
Billets, hard ..	8	2 6
Sheet bars		—
Tin bars d/d ..	6	5 0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.76
No. 2 foundry, Valley	19.26
No. 2 foundry, Birm.	21.00
Basic	19.26
Bessemer	19.76
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.10
Sheets, galv., No. 28 ..	4.25
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
„ furnace	—
Durham & North.	
„ foundry	—
„ furnace	52/6
Other Districts, foundry	—
„ „ furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	23/-
„	28×20, „	46/-
„	20×10, „	—
„	18¾×14, „	—
C.W.	20×14, „	—
„	28×20, „	—
„	20×10, „	—
„	18¾×14, „	—

Terneplates 28×20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/10/0 to £16
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 0 0 to £6 10 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60%	.. 50%
Water ..	55%	.. 45%
Steam ..	50%	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Sept. 9	59	0	0	dec. 2/6
,, 10	58	17	6	,, 2/6
,, 13	58	17	6	No change
,, 14	58	17	6	,, ,,
,, 15	58	15	0	dec. 2/6

Electrolytic Copper.

	£	s.	d.	
Sept. 9	66	15	0	No change
,, 10	66	15	0	,, ,,
,, 13	66	15	0	,, ,,
,, 14	66	15	0	,, ,,
,, 15	66	15	0	,, ,,

Standard Tin (Cash).

	£	s.	d.	
Sept. 9	302	10	0	inc. 20/–
,, 10	305	5	0	,, 55/–
,, 13	309	10	0	,, 85/–
,, 14	307	15	0	dec. 35/–
,, 15	310	10	0	inc. 55/–

Tin (English ingots).

	£	s.	d.	
Sept. 9	301	10	0	inc. 30/–
,, 10	304	5	0	,, 55/–
,, 13	308	10	0	,, 85/–
,, 14	306	15	0	dec. 35/–
,, 15	309	0	0	inc. 45/–

Zinc Sheets (English).

	£	s.	d.	
Sept. 9	42	15	0	No change
,, 10	42	15	0	,, ,,
,, 13	42	15	0	,, ,,
,, 14	42	15	0	,, ,,
,, 15	42	15	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Sept. 9	34	1	3	dec. 1/3
,, 10	34	3	9	inc. 2/6
,, 13	34	3	9	No change
,, 14	34	3	9	,, ,,
,, 15	34	5	0	inc. 1 3

Lead (English).

	£	s.	d.	
Sept. 9	33	10	0	dec. 5/–
,, 10	33	5	0	,, 5/–
,, 13	33	5	0	No change
,, 14	33	5	0	,, ,,
,, 15	33	5	0	,, ,,

AVERAGE MONTHLY PRICES OF IRON HOOPS.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 4
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 8
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 6
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 9
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 8
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 1 8
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 10
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5½
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 1½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1½
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1½
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	—	—	—	—	—

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COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

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XUM

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ENGINEER, disengaged, desires progressive appointment in Supervising or Maintenance capacity, where energy and ability, combined with tact, essential. First-class marine and general, extensive experience chief engineer, administration and control of personnel. Absolutely strict integrity. Excellent references and testimonials. (5861)

EX-OFFICER, single, age 31, anxious to go abroad, capable, energetic, and used to a hot climate. B.Sc. degree metallurgy. Thorough knowledge of bookkeeping, exceptionally quick at figures. (5730)

ENGINEER, aged 34, full apprenticeship Clyde and afloat, clean record, desires appointment as Shift Engineer, Power station, or as Engineer on rubber or tea estate, with prospects. (5589)

QUALIFIED MECHANICAL AND ELECTRICAL ENGINEER, A.M.I.Mech.E., with commercial training, aged 37, 20 years' experience General, Railway, and Ordnance Engineering, held responsible positions, including Works Manager, anxious to obtain position suitable to my qualifications and experience. (1337)

AUTOMOBILE ENGINEER wants situation where experience, efficiency and individuality are required; management of transport fleet or motor business; something big; economics studied; payment on results. 5,304.

ENGINEER, aged 38 years, 12 years' experience Colonial Railways; recently been superintending locomotive construction on Continent; competent, energetic; prefer work abroad, Kenya, South Africa; good organiser; used to handling men or large contracts. Dis. 96.

FOREMAN, Millwright, Inspector, Draughtsman, Toolmaker; varied experience; able engineer; steady and persevering, with ability to organise work and expedite production. 699.

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PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.). 146A, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

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SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

PNEUMATIC HAMMER, 5-cwt., by Peter Pilkington, Limited, belt driven, with 2 ft. dia. W.I. pulleys, 5½ in. face, all on solid C.I. base; in excellent condition; £150.—G. SCAMMELL & NEPHEW, LIMITED, Fashion Street, Spitalfields, E.1.

PUBLICATION.

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CASTING FLUX for all non-ferrous Metals. Its use is a gain, not an expense.—Write to WILLIAM OLSEN, LIMITED, Hull.

GOGGLES.—All styles, clear and coloured glasses; Protective Garments of all kinds.—LAWSON WALTON & CO., LTD., Newcastle-on-Tyne.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

LEGGE'S IRON CEMENT

Reliable for Ironfounders and Engineers.

Permanently rectifies defects in Castings and Leaking connections in Steam, Gas, Water, &c.

STANDARD Quality, 1/- lb. We also make lower grades.

F. THOMPSON LEGGE & Co.

43, DUKE STREET LIVERPOOL

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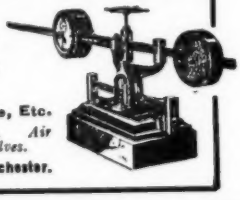
TRANSVERSE TESTER

FOR THE FOUNDRY.



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